

November 14, 1960

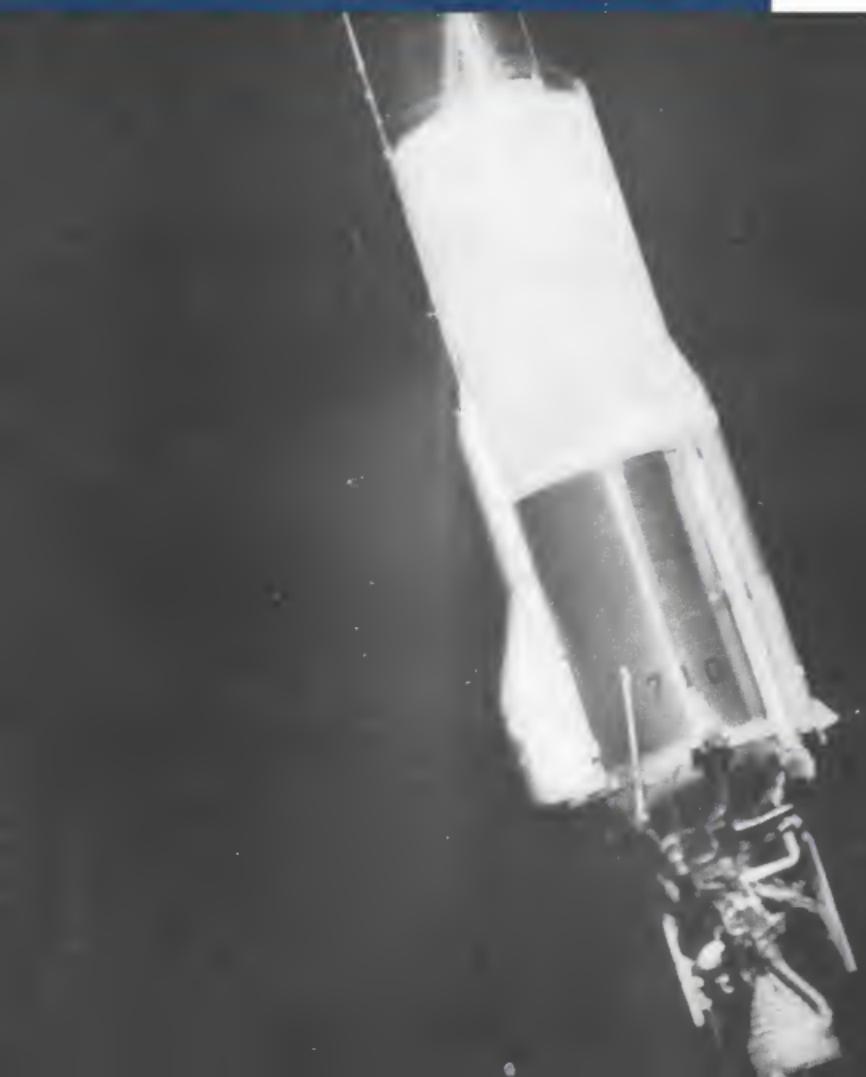
Aviation Week

and Space Technology

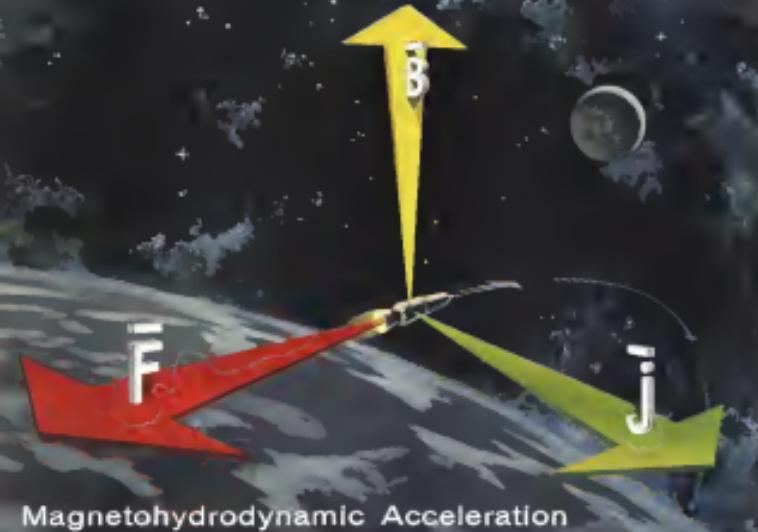
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Supersonic Data**

Convair Atlas
At 250-mi. Altitude



ANOTHER ASPECT OF THE MARQUARDT MISSION



Magnetohydrodynamic Acceleration

Preliminary visualization by ASTRO, Marquardt's division for research into the space-age, indicates that the magnetohydrodynamic concept offers unique and attractive performance characteristics. For example, once placed in a low altitude satellite orbit, this device can compensate for air drag or change the orbit position—all without the expenditure of propellant. The energy is supplied by a solar-electric power system which accelerates the propellant air by steady magnetohydrodynamic (MHD) forces thus producing the propulsive force.

The accelerator of the MHD ramjet works in much the same way as an electric motor. A steady electric current (J) is passed through a conductor (second air) in the presence of a magnetic field (B). This combination of fields exerts a magnetohydrodynamic body force (F) on the second air which drives it to high velocity.

Another important application of the MHD accelerator is in the electrical rocket for use in an extra-terrestrial environment.

In this application the propellant is supplied from a tank and heated by an electric arc before passing to the magnetohydrodynamic accelerator.

ASTRO's continuing studies of magnetohydrodynamic acceleration typify but one aspect of The Marquardt Mission.

Creative engineers and scientists needed.

ASTRO DIVISION

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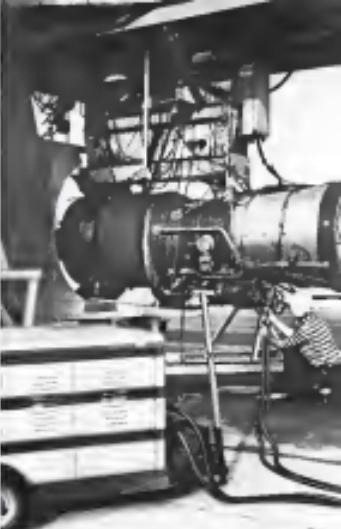


CAPABILITY is spelled h-y-d-r-a-u-l-i-c s-t-a-r-t-i-n-g

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Auxiliary power units pioneered for aircraft starting, starting by Vickers combine high efficiency with minimum size and weight for the power delivered. Because starter characteristics are closely matched to engine requirements, they provide smooth, steady acceleration of the engine through the frequent range, giving the best possible chance of proper "lighting off" and avoiding damaged starts.

Dual-purpose units developed by Vickers as an outgrowth of pioneering work in hydraulic starting offer further benefits in weight savings. These units are used as a motor in engine starting, as a pump to supply auxiliary power during normal operation. Reduced cost and ground support requirements plus increased versatility and simpler remote area operation are other major benefits. Write for Bulletin A-8001.



PROVED PERFORMANCE of hydraulic starting for jet aircraft is demonstrated by the cost that has been saved more than 2,500 hours of flight starts in a 2 year period. Cost savings are due to avoidance of use of other starters and to a 30% heavier power requirement is only 25% of that needed for other starting methods due to inherent high efficiency of the hydraulic transmission.



JET PROP STARTING demonstration uses engine-mounted starter motor and ground car power supply. Starter cost saved of approximately \$2,000 per unit resulted in 36.8% to 40.0 saved during course of observed flight starts.

MULTI-PURPOSE PUMP MOTOR develops pump when driving hydraulic starter becomes motor during normal flight to drive 15 KW generator. HELICOPTER STARTER (hyd) is 35 hp unit, starts 3,000 shaft to engine ready.



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AVIATION CALENDAR

(Continued from page 5)

Jan. 20-Cafe Hall, Detroit, Mich.
Int'l. -Society Annual Meeting, American Astronautical Society, Dallas, Tex.
Jan. 27-19-Winter Instrument Attenuator Conference & Exhibit, Instrument Society of America, Reliance Hotel and Grill, Atlanta, Ga., 8:30 a.m.-5 p.m.
Jan. 27-28-9th Annual Meeting, Institute of the Aerospace Sciences, Hotel New York, New York, Night Dances, Jan. 28, 26.
Feb. 13-Second Winter Military Electronics Conference, Institute of Radio Engineers, Sherman Hotel, Los Angeles.
Feb. 14-5th Annual Propulsion Conference, American Rocket Society, Salt Lake City.
Feb. 15-17-International Solid-State Circuits Conference, Institute of Radio Engineers, University of Pennsylvania, Philadelphia.
Mar. 5-9-6th Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Bremerton Hotel, Washington, D. C.
Mar. 10-12-1970 Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.
Mar. 9-10-Flight Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland Clinic (invited).
Mar. 12-13-1970 Congress, American Society of Mechanical Engineers, Hotel Wilshire, Los Angeles, Calif.
Mar. 13-14-Night Testing Conference, American Rocket Society, Los Angeles.
Mar. 15-16-Test Operations and Support Conference, American Rocket Society, Sherman Hotel, Los Angeles, Calif.
Mar. 26-28-1970 National Conference on Aviation Education, Northwest Hotel, Washington, D. C.
Mar. 29-31-International Conference on Space Research, University of Wright-Patterson Air Force Base, Dayton, Ohio.
Mar. 30-31-1970 Western Metal Education Association, Inn of the Marine Pacific Auditorium, Los Angeles, Calif.
Apr. 4-10-International Symposium on Electronic Devices and Their Operation of Gas-Cast Plastic Polymers, Institute of Electrical Engineers, London, United Kingdom.
Apr. 9-11-Driving Recovery Vehicles Meeting, Materials & Design Association, American Public Safety Association, Atlanta, Ga.
Apr. 17-18-1970 Test Conference, International Air Transport Ass., Queen Elizabeth Hotel, Montreal, Canada.
Apr. 18-20-Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Menlo Park, Calif.
Apr. 20-22-General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.
Apr. 26-28-Detectors & Detectors, Photonics Conference, American Rocket Society, Hotel Biltmore, Fla.
Apr. 30-May 1-National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.
May 12-14-1970 Thermal Insulating Conference, Hotel Marquis, Chicago.
May 16-17-4-1970 French International Air Show, Le Bourget, Paris, France.

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missile equation

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all systems capabilities of IBM

IBM's experience in data processing and data communications, supplemented by an extensive background in data acquisition, adds up to a three-way capability for developing, producing and integrating total automated systems. This capability is being advanced through continuing research in miniature high-speed devices for high-reliability guidance systems of the future.

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IBM

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For example:

U.S. Steel uses a KIN-TEL system to set aside open hearth furnaces. The Los Angeles Department of Water and Power uses an far remote viewing of water level meters. Convair Douglas Lockheed and Northrop all watch rocket tests with KIN-TEL systems.

Westinghouse watches nuclear power reactor tests with use.

American Petrol. and Chemical monitors conveyor lines and warehousing operations with use.

The San Francisco Naval Shipyard uses now to guard against pilferage.

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What is a Kin-Tel Closed Circuit TV System?

The basic system manufactured by KIN-TEL consists of a rugged, yet sensitive camera that is small enough to hold in your hand, a monitor that displays pictures that are twice as sharp as you can get on your home TV set, and a camera control unit that is as automatic as the only control you have to touch is the on/off switch.

More Than Likely, Your Firm Can Use Such a System.

For use in one or watch rooms or situations that are before, difficult dimensions or even impossible for men to watch.



Dependable remote TV systems are where men cannot survive. KIN-TEL has treated the extreme environment to make KIN-TEL systems both efficient and reliable jobs dependably, indefinitely, safely, inexpensively.



All types of visual information—from industrial environments to people—Easily transmitted and received over long distances. KIN-TEL's remote systems cover mining, reduce errors and confusion, speed operations.

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Remote control from your office—around whether seasonal and temporary, across block, deep or remote areas—where many operations at once, must all interrelate to a central monitoring point.



Watchmen study operations stored by a remote viewer. Such systems permit mass viewing that gives each station an integrated view, provides the cost, facilities, and experience, reducing plant losses.

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KIN-TEL—pioneer and leader in closed circuit television

Here's What a Kin-Tel System Can Do for Your Business

It can do what it is doing right now for hundreds of other firms. It can increase the over all efficiency of your entire operation. It can help you tighten production and inventory controls, help you reduce costs, increase production and efficiency. It can reduce errors and confusion and duplication. It can cut costs. It can save you time and money. It can save valuable men from tedious and dangerous tasks. It can help you the market leader remain in sharp focus in this highly competitive market.

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8 Reasons Why So Many Firms Insist on Kin-Tel TV Systems

1. **Reliability.** KIN-TEL equipment is the most reliable in the industry. It is the best choice for KIN-TEL and other media programs that require an off the shelf circuit to accomplish with reliability.

2. **Picture Quality.** KIN-TEL has resolution pictures maximum resolution, excellent for continuous observation of complex operations, and for examination of printed material.

3. **Automatic Operation.** KIN-TEL TV is the only closed circuit system that allows entirely automatic through the line compensation for light level changes of power measured in watts.

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DIA-1C	Air-Melt Alloyed	234,000 (31,200)	261,000 (34,330)	9.0%	20.6%
Brazit	Air-Melt Alloyed	235,000 (31,300)	284,000 (37,600)	9.1%	19.7%
901 Regular	Alloyed	114,000	160,000	18.8%	25.6%
901 H-Strength	Alloyed	121,000	174,000	19.2%	30.3%

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To some, the promise inherent in much we explore today may sometimes be hidden in such exotic terminology as magnetohydrodynamics, cryogenics, spin resonance, ion propulsion, plasma physics. In these and other fields, our resolve to bridge the gap between initial inquiry and induction to practice will expedite the widespread application of these new technologies.

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EDITORIAL

Supersonic Transport Race

A major program requiring scarce funds at an international government level is the effort to develop a supersonic transport. Since President-elect John Kennedy stressed during his U.S. campaign, so much in his successful campaign speech, his "all's well with the world" opponents, he should be especially interested in the supersonic transport race. For the progress in successful development of a supersonic transport will be a major index of international technical prestige in the final year of his initial administration. Proof of which country really won this race will be readily evident to all the world. The winner will simply get the major share of orders for this type transport placed by the international airways outside the Sino-Soviet Bloc.

This is in a sense in which U.S. prestige is still high. Almost all the supersonic transports in the transatlantic trade today are built in Russia at Toulon at Long Beach. A steadily high percentage of supersonic transports operated over other international routes by airways of all flags will be of U.S. manufacture, with the Convair 880 and 900 series joining the Boeing 720 series and the Douglas DC-8s. This unmistakable supremacy in the jet age is simply a continuation of the U.S. tradition of transport manufacturing excellence begun in the present era of the DC-3 and maintained in the postwar passenger days with Lockheed Constellation, Constairline and Douglas DC-6 and 7s.

With this long tradition of superiority in the international transport equipment market, it would indeed be a simple blow to U.S. prestige ahead of some other flag if we lost a successful, long-distance supersonic transport.

Fortunately, there have been Americans with sufficient technical vision to perceive the requirements for supersonic transport development. Lockheed, Boeing, Douglas and Convair have all spent some of their own money and technical resources in exploring this area. General Electric and Pratt & Whitney are developing the component powerplants for this speed range. In the government, men such as John Stack of the National Aeronautics and Space Administration and E. R. "Pete" Genna, Federal Aviation Agency administrator, have devoted their efforts to managing the initial steps in this technical spectrum. They have also prepared plans for an effective national program to work swiftly and steadily toward bringing the supersonic transport into being as another chapter of U.S. leadership in dependability, economic returns.

This program developed by FAA proposes to utilize fully the resources of NASA, the Air Force and the leading transport manufacturers in a truly national program. It is obvious from even a preliminary consideration of the factors required that they are far beyond the resources of any private corporation. This program is now in the White House on President-Elect Kennedy's desk, where it will doubtless come to the attention of President-elect Kennedy if he looks carefully for it.

However, there are signs that an international agreement may scuttle the program during the next regimen before Sen. Kennedy formally assumes executive authority. Coalitions in the press appear to be the

Air Force and its allies now operating at the Secretary of Defense office level. It would appear from recent comments and grunts at the White House that USAF, at least some of its powerful leaders, would like to keep the supersonic transport project as a strictly military program under its exclusive control.

The course for this position is apparently a feeling that the supersonic transport can be readily hatched from the B-70 Mach 3 booster program now under way at North American Aviation. We can understand USAF's sensitivity about anything even remotely engaging on the B-70 program. It has fought a desperate battle to prevent this important weapons system from being killed by financial difficulties during the recent budgetary battles.

However, we think the Air Force position in attempting to pull a national supersonic transport development program under the B-70 booster blanket is basically erroneous. The B-70 program stands at a major state-of-the-art advantage in pushing aeronautical experimental aeronautics beyond Mach 3, the point to which current technology has already carried military aircraft. Technical history of the transport industry indicates that development of a successful commercial transport design always begins a positive disease toward the next advanced military development to take full advantage of its methods and to fully incorporate all of the new knowledge it generates into a dependable and economic machine. For example, 10 years of developing B-47 and B-52 jet engines provided the Boeing 707's inherent turbo jet engine. It does not seem particularly sound to try to bring along a Mach 3 and transport commercially.

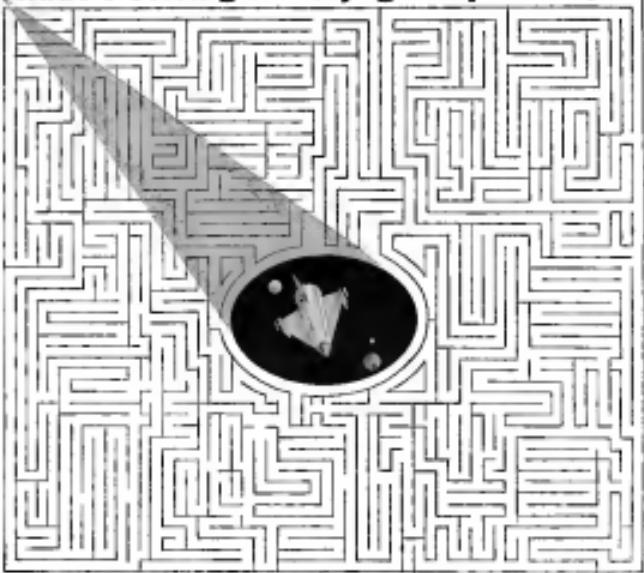
Also, we think it would be a great mistake to make the supersonic transport development program a purely military venture. With all due respect to USAF's inclined capability, we do not believe they have the environment perspective to successfully develop a transport that would be operationally attractive to either domestic or foreign airways. The supersonic transport must be designed and developed with the operating economy of commercial airways in mind. Any departure from the start or it will be a dismal failure in the international market.

It is already evident that we are in an international technical race to develop the supersonic transport. Britain has designated the British Aircraft Corp. to carry its flag in this race, while the French company of Sud Aviation and Dassault was organized some time ago to plant the French firmly in this field. Soviet designers and politicians have made it clear that they are also working in this area.

We strongly recommend that the new Administration pick up the supersonic transport ball at exactly as possible. It should have a sound working program ready to present to Congress in January, incorporating both military and civil requirements and drawing as much of the best technical resources available. This program should also be vigorously presented next April to the supersonic transport symposium of the International Air Transport Association, where the airways of the world take their first hard look at this subject in Montreal.

—Robert Hite

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WHO'S WHERE

In the Front Office

James T. Decker, vice president/division, Pneumatic Engine & Airplane Corp., Hagerstown, Md. Due to his association with New York Airplane Inc., Greater Louisville and regional aircraft, Decker's interest here will continue actively as a consultant to the corporation in the development of VTOL/STOL aircraft.

San Diego (Child) operations of Ryan Aeronautical Co. are organized as a separate division, the San Diego Division, and Edward G. Ehl has been appointed vice president and division manager. Appointed vice presidents on the new staff: G. A. Bollwagen, finance; Frank W. Fink, engineering; H. E. Kuhn, manufacturing; William Wig and W. E. Kuhn, environmental studies.

William H. Egan has been promoted to director, Nuclear Cooperation of America, Denver, N. J.

Ken Aho, Otto A. Rehemeis (1968, mkt.), vice president-marketing, Argus Electronics, Inc., San Jose, Calif.

Charles G. Gosselin, vice president/marketing, Hayes Stirling Co., division of Unisys Corp., New York, N. Y.

Ray E. Wootton, vice president and technical director, Litton Worldwide Trade Corp., with headquarters at Duluth, Minnesota.

Thomas O. Moulton, vice president and administrator, Stanley Aviation Corp., Denver, Colo.

Richard N. Cole, executive vice president and sales manager, International Air Service Inc., San Francisco, Calif.

J. A. M. Mitchell, vice president/marketing, Vitec Electronics Inc., a division of Vitec Corporation of America, New York, N. Y.
G. M. Eric, division chief, Material Program Division, Bureau of Facilities and Materiel, Federal Aviation Agency, Washington, D. C.

Honors and Elections

Dr. Charles Star of North American Aviation, Inc., has been elected to Executive Board of the American Institute of Aeronautics and Astronautics, in recognition of his outstanding leadership in the aircraft engineering field.

Changes

Dr. Charles E. Stevens, division director of research and head of the newly formed scientific division of Hawker Siddeley Division of United Aircraft Corp., Waukegan, Illinois.

George J. Devereux, manager Maintenance Department, AFM Oct. 1, 1968, Airframe Laboratories of Schenectady Electric Products, Inc., Schenectady, N. Y., and Robert D. Gray, technical program manager.

Robert H. Bremner, general assistant to the director, Office of Technical Information and Analysis, Material Assessment and Review Administration, Washington, D. C.

Philip Basso, design specialist, nuclear and space systems engineering, Advanced Design Section, Douglas Aircraft Co., Inc., Santa Monica, Calif.

[Continued on page 149]

INDUSTRY OBSERVER

Crescent-Aero team will propose a medium-size Apollo vehicle shaped as an mostly symmetrical lifting body with no appreciable wing surface. No pressurized hull will be used during the vehicle's reentry maneuver and landing will be planned for a dry lake near Edwards AFB, Calif. Team led by Convair, General Electric and Martin are conducting Apollo feasibility studies for NASA.

Air Force is expected to award a \$15-25 million contract for the Dyna-Sear communications/electro-lift subsystem by mid-December. Representatives of Boeing, the vehicle assembly and test contractor, were called to Wright Air Development Division last week to hear a report on a recently completed WADD evaluation of 16 proposals which were received from Bausch, Collins Radio, GE, IBM, Litton, Motorola, Packard Bell, Philips, RCA and Western Electric. Weapons System Project Office is evaluating several proposals from 13 companies, and a decision is expected early next year.

Finally or soon is using half of a light STOL transport capable of flying 910 or 1,210 mph with a 3,000-lb payload. There is \$36 million committed for the project in the five-year military program. Bidder include Dornier, Dregen and Mississauga.

■ Bid for atmospheric propagation and test system (APATS) for Lockheed's Iridium (high-altitude orbital transponder) due October. APATS, estimated to cost \$1.2 to \$1.5 million, is the satellite control and testbed element of the Iridium space communication constellation. Didders include Atos, Electronic Engineering Co. of Calif., Electro-Instruments, Bausch-Felipe-Franzen Division, Normandie, Otto Elevator, Packard Bell, Radiosonic, Inc., RCA and Temco.

■ North American Aviation is studying variations of human-fair flow control for application to the Mach 2.5-3 transport which could logically stem from the B-70 Mach 3 booster development program.

■ Proposals for an electronically controlled position photographic mapping system to be used in aircraft below 15,000 ft, will be received until Nov. 30 by WADD. An integrated graphic and photographic system. It will be required to have better accuracy than currently available systems and to reduce actual low-accuracy time 50%. Bidders are expected to include such firms as RCA, Lockheed, Convair, Searles, Motorola, Fairchild Camera and Instrument and Chicago Aerial Industries.

■ One top contractor in the Project Stargate satellite payload competition is RCA's Astro Electronics Division. Relativistic Missile Division received proposals from about a dozen companies to develop the payload for the strategic satellite/interceptor vehicle.

■ New Navy anti-submarine project, PLFS (Proposed Underwater Front-Counter Feasibility Study), is based on a highly advanced, well-organized study in its still a study. last Electric Boat Co. and several other companies are developing leadlines and some sea trials have been made. Sputnik is to be installed in present and future submissions.

■ Flying testbeds for the no-service VTOL transport prototype will be broad enough to permit proposals for any type aircraft in this category. Test aircraft will produce 54 prototypes for operational testing. Test aircraft will lift 4 tons, fly at 250-300 ft over a 1,700-2,000 nm range.

■ Itochukai Heavy Industries, Ltd., has a license agreement to produce the General Electric T58-100 turboshaft helicopter engine and its CT58-100 commercial version, but the Japanese and U.S. governments still have to approve the deal. Japanese company also is licensed to produce GE T58 turboshaft engines.

■ Soviet Academy of Sciences has established the Shershnev Astrophysical Observatory in eastern Astrakhanid, near the Caspian Sea.

USAF Launches Anti-Satellite Program

Saint to begin with three-year demonstration phase; \$60 million project calls for four test interceptions.

Washington—Defense program to pit satellites with interceptors, intercept and kill satellites against undetected, potentially hostile satellites is being started by the Air Force under Project Saint, drawing three years of planning and preliminary studies.

A three-year demonstration phase—costing some \$60 million and calling for the launching of four target satellites and four interceptor satellites—will begin immediately after the final selection of contractors late this year.

South Africa has been considering similar systems and some U.S. officials believe Russia will have an antisatellite capability by 1983.

If the feasibility of Saint for satellite warfare is proved by the demonstration phase, a highly accelerated development program for an operational system is expected to follow.

Twenty seven firms attended briefings early this September on the candidate satellite and polished five bid documents of prime contractors for these test tasks as expected by mid-November but with approval of the system from top Air Force and Defense Department officials expected by mid-December.

Saint Launching Vehicle

Launching vehicle for the demonstration satellites will be the Convair Atlas based on the Lockheed Bell Agave B stage. Saint will be essentially a three stage consisting of the final stage propellant vehicle plus an interim stage for establishing orbit and separating the target satellite.

Launch vehicle manufacturers would share under a kill capability license if it is assumed that excess satellites over some days never weapons that could be aimed at targets on earth or at other satellite space stations in flight.

Launching vehicle for the four target satellites may be the same as for the Saint or it might be the lighter Boeing Atlas-Centaur, which is being developed to put Transsat and Comstar into orbit.

A light satellite has disadvantages since power cells for lengthening of the maneuvering satellite begining about the end of 1967 and continuing a period of five or six months.

Both target and demonstration probably will be launched into the Trans-Cape Concourse, 11,000 km into orbit because the same general trajectory as that planned for the Trans-Himalayan migration satellite (AVN Nov. 19, '71).

Operational satellites probably will be changed to heavier ones from 2 to 48 kg in orbit because of the elementary nature of the data required to prove feasibility. This would require only a limited power supply, conserving the need for solar cell panels or long

time at orbital path near enough to that of the target satellite for refined corrections to begin. Saint then would use its final propulsive stage to maneuver close enough for separation.

Maneuverability of the final stage will be one of the most difficult and important aspects of the project. The stage will require relatively rocket engines for longitudinal and transverse thrust and attitude control jets. Only a relatively small amount of maneuvering fuel will be required.

A direct intercept technique probably will be used. With this technique, the target satellite would be allowed to make one pass while ground stations pass orbital data for computing what trajectory is required to launch Saint into an intercept orbit on the target's orbital pass.

Saint probably will be launched slightly above and ahead of the target satellite during the boost phase for all power functions. Peak lead during the orbital period should be no more than about 1000 m/s.

The Agave B stage would place Saint

Saint Builders

Washington—Two aerospace firms submitted Air Force missile division briefings on the Project Saint to intercept satellite vehicles and its first test will be in September. They were given about 45 days to submit proposals.

Because of the close interrelationship of vehicle and payload, most new firms will bid in teams. Eight firms are invited but two teams and all of them will bid for the first of the four.

Those offering four briefings are: Boeing, General Electric, Hughes, Lockheed, Northrop, Rockwell, Thiokol, and Martin Marietta.

Although the bidding for the final stage vehicle only will be left to Agave, Boeing, Convair, Douglas, Martin, Minneapolis-Honeywell, North American, Sierra, and Thompson Ramo Wooldridge.

Companies attending the prequalification briefings were: Aerospace Institute, Defense Systems Division of Convair-Baltimore, Florida, Colorado, Boeing, General Electric, International Business Machines, International Telephone & Telegraph, Illinois, Florida, Sikorsky and Westinghouse.

Defense Department's Advanced Research Projects Agency has passed along some of the progress. ERMD has been given responsibility. Aerospace Corp. has technical responsibilities and research agreement with ERMD. Saint will be Aerospace's first major program.

satellites and balloons, balloon-like decoys. One method of determining mass of the target in order to estimate its subsequent weight might be to separate the intercepting satellite to move close to the target and then to reintercept again to gain mass from the target's orbital rate of acceleration.

Use of successive intercept satellites already in orbit as targets is not expected in the Saint demonstration unless the orbital characteristics of the dead satellite happen to conform to requirements of the experiment.

Use of a "piggyback" target satellite, launched with Saint and separated from it in orbit, also is considered as a likely because the orbit would be so

developmental of more powerful boosters.

The greater speed would permit

head-on impact factor from the head-on impact target.

Air Force argues that the Zeus system has to wait too long before intercepting the target to be effective. That means sending a missile without warheads or to deploy decoys during the coasting and reentry phase diminishes the threat and slows the rate of defending against it. Air Force approach is to intercept the missile in its powered flight phase.

Central Control Role

Under Zeus plans, Zeus control centers will be scattered across the country, with each center controlling a number of missile batteries. Each center will be equipped with an acquisition radar to spot incoming targets and give the signal to target radars to plot the trajectory.

The acquisition radar uses separate transmitting and receiving equipment. The transmitting antenna consists of three arrays placed in a horizontal, bi-angular pattern which can rotate horizontally in a full circle. The receiving antenna consists of a launching lens which is a three dimensional, wire-mesh patterned horn antenna associated with the ability to focus a returning signal picked up in receiver horns which rotate synchronously with the transmitting antenna.

The acquisition radar is an attempt to retain outside support links which have blocked a huge Zeus budget in the past. Dr. J. P. Russin, assistant director of defense research and engineering for AF-ICBM program, said as early as October 1970 that the acquisition system would enter service during the fiscal 1982 budget but didn't well along.

The original idea of involving Defense and White House representatives in an attempt to retain outside support links which have blocked a huge Zeus budget in the past Dr. J. P. Russin, assistant director of defense research and engineering for AF-ICBM program, said as early as October 1970 that the acquisition system would enter service during the fiscal 1982 budget but didn't well along.

Aerospace reasons that the system as taking orbiting satellites could not be operational before 1975 and therefore wouldn't emerge in some of the Zeus schedule. Army acquisition and AF-ICBM program has progressed so rapidly in the past six months that the service review could well be ready before budget is presented to Congress to handle it.

Army Campaign

Army's campaign for sharply increased Zeus funds calls for a decision to launch a full-scale production program, which would concern the Defense Department to spending an estimated \$10 billion over the next five years. Army estimates the cost of the system, but whatever the cost, the request will run into heavy opposition from the other services competing for defense funds.

Army has named a nine-study committee to work on its fight for Zeus production funds. This group, which includes Defense Department and White House representatives, is to survey the Zeus program and decide whether it is being enough effort to warrant committing a large budget for production and one acquisition. Army is confident that

Army's campaign will be successful, separated from the rest of the program. The defense budget of \$10 billion will be available to the Defense Department for defense funds after the Air Force's \$10 billion budget is taken into account. Separately, Defense Department, a small track radar to guide the defensive missile to intercept, a simpler shock波波前波 and more launch and guidance commands to the missile, and the Nike Zeus anti-satellite missile that has been developed.

Zeus Configuration

The 10-ft. Nike Zeus missile will have three stages, all solid propellant. The first stage has four fixed fins with leading edge and flat top. Second stage has four fixed fins, and the third stage has four controllable delta fins.

First stage, powered by a Thiokol motor, furnishes 320,000 lb of thrust. Second and third stage have Central Control.

Parking Orbit

Technique of launching the Saint demonstration in a parking orbit and releasing it later to coincide with the target is not likely to be adopted because of the medium power supply requirements involved during the extended parking period.

At the Saint concept evolves into a technique of using a parking orbit to intercept and inspect the target and a separate orbiter to carry the kill mechanism, the parking orbit might be used for the weapon satellite.

Saint demonstrators probably will have only a television camera and a timer for inspection since the experiments will be programmed only to prove that the target has been killed. This might be the first use of such in a satellite.

Initial launch distance requirement may not exceed 30 km so an estimate of how precise the parameters may be for the initial separation distance between Saint and the target. Inspection, however, might require the Saint to approach the target at closer to 30 to 100 m. Operational Saint probably would use orbital rates, IV, reduced orbital rates, distance measurements and television cameras to determine if the target contained a nuclear weapon.

Inspection requirements for operational satellites also would include the ability to distinguish between armed



First Flight Photo of Initial German F-104G

First flight photo of initial Lockheed F-104G Super Starfighter produced for West German Air Force shows aircraft performing flight test over at Lockheed's Palmdale, Calif. facility. Germany is acquiring a quantity of two-place F-104Gs and the single-seat F-104Gs from Lockheed's production line. Subsequent production will come from manufacturing process linking Lockheed with manufacturers in Germany, Belgium and the Netherlands.

considerably larger than the second stage, and thus it is more sharply angled, fading between stages.

Test programs for Nike Zeus missiles are now in the final stages. A U.S. missile stage, the Air Force's Multiple Range Zeus target, and other types of tubes have been installed at Associated Island in the South Atlantic where advantage can be taken of flights of Atlas and Titan ICBMs now coming into service. Data has been obtained on trajectories, decay characteristics and atmospheric boundary layer motion on older stages.

In the same area, another program, called DAMP, for development of anti-spacecraft weapons systems, is being conducted by the Army Ballistic and Guided Missile Agency for the Department of Defense's Advanced Research Projects Agency. A U.S. Army Army, the American Museum, an aerospace since February, 1958, is an on-going anti-satellite system which carries precision equipment for making optical, electronic and infrared measurements during the terminal phase of missile flights.

Data obtained from DAMP and Associated Island is being used to test programs at the White Sands Missile Range and the Pacific Missile Range.

At White Sands, a facility to launch target targets has been constructed near the southern boundary of the range. It is called ZURF, for Zeus Up-Range

Facility. Radar and guidance development tests will be performed by Bell Telephone Laboratories and Douglas Aircraft Co. All types of solid-rod tubes in the system will be orbited, along with a variety of flight launch cells and target tubes.

Missiles have been fired successfully from underground cells at White Sands at short-range ballistic missile targets. The targets have been the Nike Hercules and Sprint and Highball missiles developed by New Mexico State University.

The Pacific Missile Range will provide facilities for testing Zeus against ICBMs. Launching operations will be at Pt. Mugu, Calif., for extraction of Zeus vehicles. Eight tests of the Zeus will be fired from Kwajalein Atoll in the Marshall Islands against ballistic targets—Atlas missile and Kwajalein AFB.

In testing at Kwajalein, any deflection

is observed will be noted at White Sands and Pt. Mugu before being tested further at the Pacific site.

Construction is under way on the site of Kwajalein, Oregon, Eniwetok and Rongerik. Zeus quotes and some of the optical instruments will be received on Kwajalein January 1, 1960, and the first launching attempt will be an Eniwetok test. The remaining flights will be located on Eniwetok. Launching rate for Sprint will be 10 flights for a quota of 100 flights.

In addition to Atlas targets, Sprint and a B-47 aircraft will be used in checking out the system before it is fired against an ICBM.

To obtain background data for operation of the detection system, Project Vela, for Pacific Range Electromagnetic Signature Study, has been conducted at Kwajalein. This is a step beyond the acquisition, identification and discrimination abilities of the Zeus system. It uses 12 directions at an earlier stage—in the pre-assembly or mounting stage. Missiles, warheads and other vehicles provide individual characteristics in their returns which in later versions of the Zeus system may be added to computer data.

In further support of the development program, two enhanced radars will be delivered. Radar 1 will be supported by high altitude aircraft carrying infrared instrumentation. One radar will be Textron, similar to EMEWS radar. It is under development by Radio Corporation of America.

Textron will be used for lead-curve and recovery phases of missile flight. Precision radar, produced by Raytheon Corp., will perform the same function but will operate on a different frequency and will use a different system of data collection.

Systems manager for Nike Zeus is the Army Ordnance Missile Command, with Army Rocket and Guided Missile Agency in the system industrial supervisor. Team contractors are: Western Electric, with Bell Laboratories and Douglas Aircraft as major associate contractors.

Command Unit Failure

Widely-spread failures of the Army Cooper Command Unit, which occurs after 10 days in orbit, is believed due to a malfunction in the satellite's command decoder unit, which is supposed to turn on the transmitters when it receives the proper command from a ground station. Fault may have occurred in the switching unit which alternately turns the two command receivers on and off, with a succession of pulses intended to increase battery power. Satcom's VHF tracking beacon transmitter is still operating.

During 10 days of operation, Cooper has been on the air for a total of approximately 15 hr., totaling an overall total of 180 million television miles. Reliability problems are presently being studied by Army Research Corp. (Army May 21, p. 71), although not intended specifically for application to Cooper payload which employed considerable redundancy for added reliability, indicate a considerable use of 10 to 100 hr. for a quota of Cooper's incapacity.

Space Technology

Satellites Planned to Detect Space Blasts

By Lorry Roads

Washington—Operational satellite system designed to detect nuclear explosions in space are being developed under Defense Department's Project Vela. The present plans call for six satellites orbiting at 60,000 miles and one at 100,000 miles.

Earlier steps in this phase of the overall nuclear explosion monitoring program call for the launching of 25th "piggyback" instrument package as part of USAF Blue Star space probe payloads and flight of similar packages in Atlas, Titan and Minuteman missile near coast.

As the full scale program gets underway, experimental satellites will be launched into near highly elliptical orbits. The operational satellites will follow, being placed into circular orbits to provide continuous coverage.

Project Vela was undertaken by Defense's Advanced Research Projects Agency in September, 1959. In collaboration with the Air Force, Atomic Energy Commission, the National Aeronautics and Space Administration and Department of Commerce and Justice, ARPA initiated a research and development program designed to increase understanding of the complex physical problem associated with detection of nuclear explosions, primarily in outer space—first in the moon's orbit and a gradually reducing trajectory out to 1 million mi from earth.

It is expected that nuclear explosion radiation measurement will be included in the deep space probe payload at NASA's Pacific and Marshall Space Centers, all of which will be launched with sufficient velocity to escape the earth's gravitational pull.

Defense has made no mention of detection of tests within the atmosphere in association with Vela. It is known, however, that a large network of sensing surfaces utilizing a variety of means of detection are sustained over the world, while many types of subspace sensing devices are carried by balloons, radars, and aircraft. A number of these devices, Lida has been said, also of Project Vela, serve as ground-based detection of nuclear tests in space.

Vela—ARPA's code name for 100.3 Hz satellite—the working group of Vela Hotel, including USAF Air Research and Development Command, ARPA, and NASA.

Space Flight Progress

The 25th instrument package for nuclear flight will carry stabilization and other radiation detection devices to cover the spectrum of nuclear explosions. During the low trajectory phase of the experiments about ICBMs, the main high altitude will be 100,000 mi. Six HABM piggyback units are planned.

High altitude flights will be above 100,000 mi and will extend to as high as 100,000 mi at about 14 rock experiments are planned.

As the small packages are being sent off the 1960-1961 time period,

experimental satellites weighing 278 lb. will be put into orbit. These full-scale satellites will be boosted by the Atlas D first stage and Argus B second stage. The place will include putting these experiments into orbits with whose altitudes will be 60,000 miles and one per 100,000 miles. Each full satellite and each will have two backups in case of failure. Through telemetry means these satellites will provide an accurate signature of the radiation found between the geosynchronous and perigee for application to the operational phase.

Operational system scheduled for late 1962 or early 1963, covisons will be provided by 100 satellites. These will orbit in one set per 100 and three others in a group of 100 day to the date. The operational satellites will follow, being placed into circular orbits to provide continuous coverage.

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Vela—ARPA's code name for 100.3 Hz satellite—the working group of Vela Hotel, including USAF Air Research and Development Command, ARPA, and NASA.

At time went in the AEC started to develop explosive data, using tritium in their neutron multiplication.

With the first four atomic tests in Australia by the British government in 1956, seismologists for the first time measured information as to the contractional subsidence of that almost earth-quake-free area.

As a basis for detection of underground nuclear tests—the Soviet underground explosion and the Bluebird II series at the Nevada Test-Site—was Dr. Carl Johnson on seismology and David Ladd have become the standard test.

The first test of 1979 atomic test in Australia has been conducted by the United States, Russia and Great Britain. Of these, the U.S. has provided data on 100 shots. This data, compared with seismological results, revealed that a deep underground explosive releases about 1,000 times more energy to the source body, more field than does an air burst of the same yield, 400 times as much as a surface burst, and 40 times as much as the underground shot of the Nevada Test Site.

In diplomatic negotiations between

the U.S., the United Kingdom and the USSR, as of last week, as definitive agreement had been reached concerning a control system to detect underground explosions of seismic magnitudes 4.75 as烈 and inspection procedures for preventing the use of undetectable seismic disturbances within the USSR.

Cessna Plans Addition of Three New Twin-Engine Aircraft by 1964

By Bruce J. Boban

Wichita, Kan.—Cessna Aircraft Co. is planning to add three new aircraft to its line by 1964 and a subsequent announcement is expected to come with its newest model numbers larger than the business-class field.

To 1,200 distributors and dealers meeting here, Cessna lifted the curtain to some degree on how it plans to retain its present 20% share of the market. The new aircraft will introduce an upsurge of that goal and that appears to be the company's intent.

■ **Model 340.** A single-engine, high-wing aircraft version of the present 310 light-twin, is to be powered by 260-hp Continental supercharged engines. This aircraft is planned to join the company's 1962 line.

■ **Light-twin four-place high-wing design.** with one engine in the nose and the other in the rear of a central fairing, the rear unit supported on booms off the wing's trailing edge. Landing gear will be fixed tricycle type fitted with streamlined speed fairings of polished aluminum.

The light-twin, which is currently undergoing preliminary engineering tests prior to start of flight test program, will seat four, probably in four-seater configuration. It is scheduled to be available to purchase in mid-1962.

■ **Heavy-twin 10D.** 10-place long-wing model is projected to be ready in late 1963 or early 1964. Embodying "light-twin construction," the aircraft will feature two engines and seating for ten, similar to the 110 configuration, and a single tail.

The new aircraft are obviously planned to fit in some gaps in the company's current line, leaving Cessna's plan to produce a product in every category so that its interests may step up from one model to the next class without having to venture outside the "family."

Stepping Up

The new 110, for example, will make it possible for Cessna 150 users desiring greater capacity and speed to step up to this new aircraft, which is obviously intended to offset the new forthcoming British Bristow light-twin five-place development of the Tavell Airliner, which will be powered by 360-hp Continental British 6s in reengining the Bristow at its annual aircraft dealers meeting this month.

The light-twin is particularly aimed at the Piper Apache class, which seems to continue increasing problems

of the single-engine business aircraft who fails to step up to multi-engine options. Cessna expects the aircraft to be directly competitive in price with the Apache. A light-twin configuration was fully chosen over conventional four-engine, engine plan primarily because Cessna engineers decided that this was the optimum layout from a safety standpoint, producing engine-out performance without degradation of handling characteristics, particularly the new inherent. Lesser jet is to be company engineers as producing some flight characteristics, engine out, as a single-engine aircraft, which is not possible with a light-twin new engine in the bottom plane market are described on p. 178.

The reconfiguration, along with high-wing design, is seen as providing distributors and dealers with an important sales tool when the airplane makes field deliveries.

The company's experience has been that the philosophy that it is an outstandingly important characteristic throughout its single-engine line, such as a high rate of climb, the selected NASA 1941 aircraft configuration and spring-over-the-fairing landing gear, has not paid off. This is because of the single transition the engine has had on stepping from the lower performance to higher performance models due to their static advantages and handling characteristics.

Powerplant Not Chosen

It is felt that the high-wing configuration will again demand the aircraft's task in engine, as its single-engine Cessna prospects into the new multi-engine era. Cessna has not yet chosen a specific powerplant for the new multi-engine aircraft and indicates that the study has evaluated twelve as well as piston engines and in the later class, six and eight-blade, geared, straight, supercharged and unsupercharged configurations.

Concerning options are that the new products will be sold soon for current line of 12 airplanes, adding that presently they do not know, at least for the next several years, the dropping off rate of the current line. Implications is that by 1963-1964, Cessna will be producing 15 business-class models. This, in turn, has industry observers believing that Cessna may be the future to go to large-scale engineering structure, much like General Motors developed in the automotive field, to ease the burden of factory and dealer faced with a complex inventory problem.

He expects that this year will mean all aircraft for about 45% of all Cessna sales.

Current planning calls for increasing production to over 4,000 units in fiscal 1961, measured with last year's 3,700, and this appears to be a conservative estimate considering the favorable business aircraft market situation, the fact that Cessna dealers are starting their new model year with less inventories of last year's models, and as indicated

continued good increase in export sales.

The light-twin Model 310 field inventory situation improved so much at the close of the 1960 year that Cessna announced it was closing previous production of the aircraft, with the 3100th field, due May 15 to Nov. 29. Future sales of airplanes to its field organizations also were impressive. At the conclusion of the distributor-dealer meeting last year, some 375 demonstration models worth more than \$4 million were a main factor from the factory. This year some 40 approximately will new Cessna which will have been received for delivery between the last week of October and the end of November according to Frank Martin, Company source indicated that the last aircraft already had the delivery order from its sales organization for much earlier than scheduled 1961 production prior to the closure.

Cessna's export sales continue a healthy rise. Fiscal 1960 showed a volume of some \$9.25 million, compared with the previous year's \$4.6 million, according to Export Manager M. F. McElroy. Revenues in export activities is playing an important role in that increased volume, with foreign countries gradually learning that it is poor policy to purchase aircraft of older models and piston aircraft because the market for these aircraft now will support considerably more dollars later as a result of spare part costs of business and sales to specialized aircraft.

Planes valued at approximately a half million dollars, McElroy believes that with the company will ship 50 to 60 planes to Britain.

Native Air Transport Co., wholly-owned Cessna subsidiary, has daily well subsidized sales volume, as regard percentage of airplanes it is financing wholesale and retail, although overall dollar volume currently runs \$7.50 million and is expected to increase to \$11.5 million over the next two years.

Based upon utilization is that 90% of the company's distribution has developed a market for aircraft in the 100 to 150-hp class, which is the principal NAFCO product. NAFCO will probably turn up to 100 field sales representatives over a time when local tools look as favorable as financing private airplanes at these days.

Much of its activity is in negotiating financing to the distributor or dealer when his customer has reached the point where the local bank feels it does not want to go to him to obtain a reasonable amount of money or volume of aircraft.

The bank, in turn, wants to maintain a low balance on its line portfolio.

But at the well-established dealers they have even local finance sources, NAFCO is helping newly established dealers with their first year's sales and acquiring the necessary tools and service fees low, American Service. Cessna Britain, which was named a Cessna distributor only a year and a half ago, has increased its business to the point where it is reorganizing its operations to separate its business aircraft activity completely from its other aviation activities to provide better concentration of effort. British lessees is building rapidly, in the past year Cessna delivered 26 air-



Production JetStars Readied for Flight Tests

These production Lockheed JetStar tandem transports and the prototype (left) Lockheed 1049G aircraft shown on the tarmac. Cessna plans to field 10 aircraft for flight testing to receive and adapt tank gear. Aircraft are being used for Federal Aviation Agency certification test programs. In left background is a Cessna 310.

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The following begins to be a short

list of the company's activities.

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Little Joe Test of Mercury Capsule Fails

By Edward H. Koloski

Washington—Staples misfire setback in the Project Mercury test flight program came hot with when an electrical circuit failed under high acceleration loads, preventing separation of the capsule from the Little Joe booster and delaying orbital demonstration of protective capsule structural integrity.

National Aeronautics and Space Administration officials enough believe safety on the flight to establish cause of the failure of capsule and hence to separate as a separate safety failure. Insurance office has begun to correct the defect by change in wiring or switch settings.

The flight will be rescheduled as soon as possible, since cuts in the safety of the capsule in withstand maximum dynamic

Mercury-Redstone Delay

Washington—Delayed test flight program came hot with when an electrical circuit failed under high acceleration loads, preventing separation of the capsule from the Little Joe booster and delaying orbital demonstration of protective capsule structural integrity.

Redstone test is a probe to safety test Mercury pilot training flights with Redstone, at least one of which it is to be made before rescheduled orbital flight to the Mercury program.

Reschedule is considered necessary to qualify the capsule.

Test at Wallops Island, Va., set for the 5th and 6th NASA had scheduled as the Little Joe booster series. Earlier

flight several occurred on July when a fault in the production capsule structure in a high angle of entry could not be made because of an Atlas launch vehicle failure (AW Aug. 8, p. 36).

Qualification Test

Flight test work was designed to qualify the production capsule in an escape maneuver at low altitude, 100 ft. It includes the maximum dynamic forces. Structure was to have been subjected to pressure of 1,000 psi and 30g loading.

Horizontal, high angle maneuver flight also will be repeated.

Wallops firing team can put together a Little Joe booster with available motor and hardware, since no booster systems were delivered and only fire was fired. A seventh Little Joe booster is on order, but no mission has been assigned.

Reschedule was made last week to repeat the test with Little Joe, but an alternative would be to conduct maximum pressure maneuver with a Redstone booster over the all-old personnel Little Joe for test about the same performance characteristics as Redstone and not all eight Redstones purchased for Mercury have been assigned specific missions.

Redstone test should be conducted at Cape Canaveral because ground equipment is available there for the liquid motor and Wallops has no experience with large liquid engines.

Can not test now is aimed at qualification of orbital landbase produced by McDonnell Aircraft Corp. for NASA, emphasizing demonstration of structural strength, ejection system landing characteristics. Even Little Joe has been used NASA produced capsules to high loads to verify capsule design and flight qualify escape and precision landing systems.

Capsule Configuration

In the flight test work, a beryllium heat shield was used on the capsule, but skin heat shield will be used on the modified orbital vehicle. General arrangement and internal arrangement of the Little Joe capsule was identical to the recovered orbiter except for the shield and shape of the parabolic. Parachute is round in the first Joe McDonnell capsule, and was redesigned to be larger and rectangular in subsequent modified.

Booster-capsule separation was to have occurred 25 sec after launch. The second stage, the escape sequence was to have been initiated and the capsule at an altitude of 15,000 ft.

Booster test Little Joe, with capsule and escape tower still attached, was



PRODUCTION MODEL of Mercury space vehicle is mounted atop Little Joe booster at Wallops Island, Va., for test of structural integrity of the capsule and its escape system.

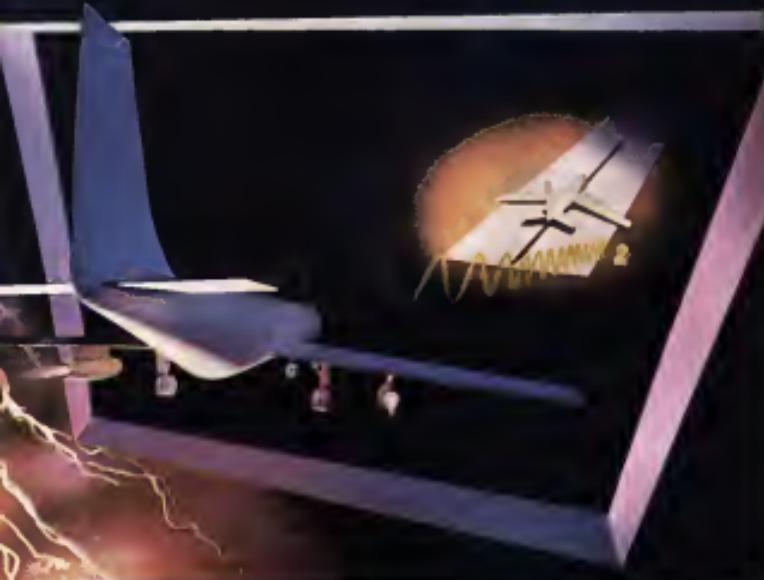
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Now, for the first time, Cameron's carefully controlled electric furnace steel and unique forging processes make possible this remarkable SPIN BLANK for a SOLID FUZE, MISSILE C-1552 AIR TO GROUND. Forged from a solid billet of Cameron AMS-256 steel on an 11,000-ton press this blank is 54" O.D., 5" wall thickness, 26" long. We have made similar pieces down to 30" O.D., 3" wall. But, large or small, the extreme working during forging effectively breaks up all non-metallic segregation and makes unnecessary the expense and delay involved in obtaining vacuum melted steel. Optimum grain flow pattern, maximum strength and ductility, and minimum machining allowance make for the most precision metal. Only Cameron can do it—so, for your next job, ask Cameron.

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Bell's All-weather Automatic Landing System—consolidated

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Today's increasing air traffic demands faster and safer all-weather operation at every airport.

Bell brings this goal one important step closer with its All-Weather Automatic Landing System (ALBS) which can fly two airplanes to touchdown every minute, even when visibility is absolutely zero.

The Bell ALBS takes over when the pilot brings his plane through the electronic "window in the sky" and guides it to a safe and controlled landing.

The system has been flight-proven in more than 4,000 landings with all types of aircraft—small private planes as well as airliners from the DC-9 and DC-10 to the huge Boeing 707 jet. It is now being evaluated at FAA's Na-

tional Aviation Experimental Center, Atlantic City, N.J. Unlike other automatic landing systems, the Bell ALBS is ground-based and a ground observer monitors every approach and landing. It can operate either fully automated or under pilot control.

Military versions of the ALBS have been ordered by the Air Force. The Navy has selected it as its installation aboard the carrier-powered aircraft carrier USS Enterprise as well as for its other large carriers.

The Bell ALBS is but one among many contributions which Bell Aerospace Company is making to the scientific progress and defensive strength of the free world. We invite qualified engineers and scientists to inquire about sharing our challenging and rewarding future.

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B-70 Subcontractors Reinstated

Los Angeles—North American Aviation finalized negotiations on new contracts with a number of former subcontractors last week in an effort to assure an orderly resumption of work on the B-70 supersonic bomber.

A number of contractors who were dropped from the North American team after the B-70 contract later last year are now re-awarded and others are expected to join the consortium. The dollar value of the new contracts have not been fully determined in North America. Among the contractors already reinstated and their new contracts are:

- Specialty Gageco—airframe gage platforms.
- Hamilton Standard Division of United Aircraft—airframe control and environmental control systems.
- Federal Systems Division, Instrumentation Business Machines Corp.—blown oxygen and missile guidance subsystems.
- Martin-Marietta Electronics Center, Materials-Science and Traffic Control subsystems.
- Westinghouse Air Arms Division—defensive subsystems.

IBM's Federal Systems has been working on the boundary subsystem under a short procurement contract after last year's B-70 cutback. This direct contract will be terminated by North American.

Other major B-70 contractors for which new contracts are being negotiated with potential subcontractors by North American are the boundary power system, flight management systems, landing gear, engine air ducting, slat pod and fuel management system.

landed to 73,000 ft altitude, and then it touched down on the Atlantic about 33 mi. from Key West. Now the scene was the USS *Enterprise*, a Navy ship and these Marine HUSS helicopters.

Soaring attempts began immediately for the booster-capacity system, which had a weight of about 25,000 lb. in air transport and 20,000 lb. in use.

Marine boost-jettison capsule and upper stages were the basic parts. In its stage, monitor sequence, primary rocket did not fire as it would in a normal flight to carry the capsule and from the booster after separation. The escape rocket performed this operation in one shot, and it is designed to pull the one-time capsule about 2,000 ft. from the booster.

This was the primary indication that the escape rocket had not uppered about 500 ft. higher than planned. It is unlikely that the escape tower was positioned, as was planned.

Launch was delayed a day because of bad weather, and the flight was made under variable wind conditions. High winds over the beach caused launch angle depression of 2.5 deg. to 5.5 deg. Actual impact at 33 mi. was 5.5 deg. further than planned.

Flight director Lt. Col. Joe Schmitz said the two flights were "a success." For the first flight and the second, the upper and lower stages had provided thrust of about 250,000 lb.

Test was the seventh solid-booster vehicle shot in the Mercury program, four of which have provided the desired data, one considered partially successful and two unsuccessful.

Summary of flights

- **Joe II** (first) Sept. 9, 1959—successfully demonstrated drops, chariot acceleration and altitude type, but failed with an Atlas booster.

- **Little Joe I** launched Oct. 4, 1959—qualifying, eight-stage booster with full-scale capsule model.

- **Little Joe II**, launched Nov. 4, 1959—a patrol mission with a high dynamic pressure short duration, using a booster.

- **Little Joe III**, first flight, Dec. 4, 1960—successful test of escape system at high altitude, with the boosterite model containing a capsule.

- **Little Joe IV**, launched Jan. 21, in high pressure short, with a booster.

- **Mercury Atlas I**, launched Feb. 20, in an unsuccessful high-high抛弃 test of a production capsule.

- **Little Joe V**, launched Nov. 8, in an unsuccessful high-pressure short test with a production capsule.

One additional McDonnell capsule was tested as an off-the-pod short maneuver May 5. No booster was used in this successful test.

Navy Reports Gain in ASW Capability

Explosive rates of technological advances have given the U.S. Navy much more effective anti-submarine capabilities than it got a few months ago. Rear Admiral Lloyd M. Marshall held a New York meeting of the National Security Industrial Area last week.

Marshall, who is ASW Readiness Executive, Office of the Chief of Naval

Operations, claimed emphatically that U.S. capabilities in the field of underwater warfare were "world ahead" at any similar Commandant-like capabilities. Only if the Communists were to run out their nuclear fleet of approximately 300 submarines of all types to nuclear power would they pose any real threat to the U.S. Marshall added, and emphasized that this could not be done overnight.

Tell U.S. effort on ASW was to studies early operating theories. These are now being refined, he said, and gave overall strength figures of 1,300 aircraft, nine carriers, 268 nuclear ships of the deuce categories and 100 submarines with anti-submarine capabilities.

Underlining the importance of an aircraft in ASW, Marshall said that an ASW aircraft can be effective in combat and can add up to much more than what the aircraft itself can do. In aircraft versus conventional operations, he said, team speeds of 20 times the capability of single efforts and the should add that figure could be as high as 30 to 50 in specific cases.

Future technical growth in the field is expected to be in the electronic gear needed for the complex job of anti-submarine detection and the further development of "clear" means of detection and aircraft, helicopters and missiles. Either in service or about to be produced, much the need is growing vehicles.

Marshall outlined intelligence and Western geographic in the two biggest factors aiding the Navy in its continuing assessment of Russian strength and capability.

Beryllium on Mercury

Washington—Excellent bonding techniques for the metal Mercury module were never covered with boron to protect it from the bright light and heating expected in the one-day orbital mission.

Original design called for the capsule, which is the fiberoptic of cables, clamped and crimped for one and expansion during heating. This approach and conduct design share one main cell are covered with about 100 mils.

National Aerospace and Space Administration and the change to beryllium for the main heat shield resulted from data obtained from the Sept. 9, 1959, Big Joe flight, which selected probe temperature of 2,000° on the capsule, but only 1,000° on the main shield and 1,000° on the drop section. These allegedly nations contained 12 fire extinguishers to prevent heating initiators.

Engine Malfunctions Halt Blue Scout Test

Washington—Attempts to test the second four-stage Air Force Blue Scout high altitude probe failed last week when the second stage cut off prematurely and the third and fourth stages did not ignite.

Planned to reach 24,000 m in altitude and travel 5,000 km down the Atlantic Missile Range in a 10 hr. 10 min. flight, the probe had been raised about 110 m from the launch pad after flying just a few minutes.

Test was the second of 12 in the USAF solid propellant Blue Scout development series which is expected to lead to a 15-stage orbital launch vehicle over the next several years.

Configuration of the vehicle designated Blue Scout II, or Project Experimental Test System (PTS) 609A-D-2, was selected in the fall system integration at Space and Technology (AW 10/26, p. 26). An Air Force Special Weapons Center redesign, procurement procedures were ongoing, but the 29-kg payload carried by D-2 was 1.8 lb lighter than D-1 payload.

After the D-2 flight, Air Force and the D-1 test was not a complete success because exhaust from four-stage nozzle melted some of the insulation in the telemetry enclosure. Data on vehicle performance and from the scientific payload were taken up to 3 sec near the planned 16,000-17,000 m altitude.

Blue Scout is the name USAF will give its six-stage configuration using much of the same hardware in the National Aerospace and Space Administration's Scout launch vehicle (AW July 11).

Army Aviation Plans

Washington—Army has been requesting for a helicopter census with a 10-14 hr. test flight to develop performance and new location of developed legs—“now we have to focus on speed,” Richard S. Moore, Army's director of research and development, and last week.

Army also plans to initiate development next year of a medium surveillance aircraft with greater performance than the Grumman M-169. Moore said he felt sufficiently sure the vehicle would have “more than twice the characteristics with the speed capability” of the current aircraft which will enter its serviceability.

A short new development anticipated is a attempt no longer than the de-classified Gorham test with “considerably more capability.” Configuration and design will be influenced greatly by the recent Tri-Service V-STOL program (see p. 120, *Moore* and

111, p. 25). Unlike the fully-geared NASA team, designated primarily a small surface based, the future HETS (HTS) study consists of both unguided and guided systems.

Both D-4 and D-5 were suspended, and they consisted of Douglas XM-35 Custer test stage, Hercules Allegro Ballistics Laboratory 354 Antares test and stage, Aerospace General 18 KB-5,000 third stage, and a 17-in. diameter spherical fourth stage developed by Naval Ordnance Test Station.

Their launch was made by USAF and Food Processing Division which has equipment for extreme temperature and payload carrier design.

News Digest

Fest Polaris A2 test vehicle flew more than 10,000 m down the Atlantic Missile Range last week. Maule had a Hercules-Allegro Ballistics Laboratory second stage motor with a glass fiber case and a higher specific impulse than the A3A model's second stage solid propellant.

Fest Mausmann solid propellant (CPM) spoolers, with 58 nozzles in unguided nozzles, will become operational in October, says Fest Polaris.

United Aircraft Corp. says non-stop payload capacity Sept. 18, 1968 reached \$78,000,000, compared with 1967 results \$77,000,000, for the similar period in 1969. Net income increased to \$10,861,015, or \$1.13 per share, compared with \$21,515,640, or \$3.45 per share, for the same nine-month period in 1969.

John B. Montgomery, former vice president and general manager of General Electric's Flight Propulsion Division, has been named president of Davison, Inc., effective Dec. 15. Thomas R. Jones, formerly Davison's president, has been named chairman of the board and will continue as chief executive officer.

Mesilites & Automation (Fond) will be taken over by the Soc. Scientia and Electronica Corp. The investment company, organized two years ago to focus exclusively on the growth fields of rocketry and electronics and with Dr. Theodore Von Kármán as chairman of the board, asked the Securities and Exchange Commission last week for an order declaring that it had caused no material change.

McDonnell-Milwaukee Electronics Division and Douglas-Milwaukee Space Systems Engineering Department have undertaken a joint study to establish joint procurement design criteria and procurement philosophy for future Air Force weapons systems plus associated test and checkout equipment.

Phantom sounding rocket, developed by Rocket Power/Tekco, a division of Global Co., climbed to an altitude above 216 m during Dec. 27 flight from Ft. Aguilar, Calif.

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AIR TRANSPORT

Latin American Traffic Struggle Grows

Meeting of governments fails to reach compromise; new South American group intensifies the problem.

By L. L. Doty

Washington—Deep-rooted struggle over rate levels and traffic capacity on Latin American routes appears to be gaining momentum despite a second attempt late last month by governments involved to reach some compromise settlement for inflating saying the southern continent.

In a poorly attended meeting of South and North American states held in Montevideo Oct. 24 and 25, no agreement was reached on a number of traditionally controversial issues, but generally, sharp lines of difference were drawn that disposed once again for any early solution to the rate and capacity problem. The battle between the governments has been intensified by the Conference Internationale de Transportes Aériens (CITA), which has forced all stand against International Air Transport Ass. tariffs and standards on these Latin American governments.

The action by CITA, a group of 200 IATA member line air carriers from the U.S. and Canada, which has the full backing of the Pan American government, has forced a number of countries to take a stand on the issue of rates. The U.S. has taken a stand in favor of IATA, and Argentina has done the same.

CITA members have vigorously attacked the IATA fare table, which was the only tool on hand at the conference for discussion, on grounds that it was economically damaging to CITA members who said, that changed operate at lower levels than competitive in order to generate sufficient traffic to stay in business.

In an attempt to make some solution that would not offend the U.S. and Canada, the conference then established a various scale of rates, the regional civil aviation conference made these recommendations:

•Panama offering for a 10% differential on passenger fares for carriers not served to “underdeveloped” by their respective governments should be retained until Dec. 31. Principle of lower fares for underdeveloped areas was appreciated as an objective.

Chairman said at stake in the days by non-IATA carriers to raise a passenger fare level 20% below that authorized by IATA. Strategy of the IATA rate conference in Geneva last fall (AW Oct. 14, p. 80) called for a raise of 10% in fares, as in South America by as much as 50% below current basic objective. CITA is to make any further proceeding by non-IATA carriers sensibly appreciated.

At the same time, IATA is authorized an increase up to 10% of first-class fares in Latin America and established a fare differential between transocean flights and passenger-carrying missile flights. In addition, as a compromise gesture toward local Latin American carriers, IATA and it would consider

adopted in Honolulu in 1959 and an agreement reached earlier that year in Canada on certain Pan American routes. Chair proposed by the last, the “less developed” had a reduced defense so that it was not as was possible to determine which carriers might be charged in that category.

•Governments should consider approving one of these rate tables by April 1 unless agreed to at Cannes, any rates submitted by other countries or carriers or ones developed through a joint meeting of the countries which the conference.

•Governments should take all necessary steps to ensure that no new agreed rates are properly put into effect under rigid governmental supervision.

The proposal for a joint meeting of the current date strong opposition from the U.S. The U.S. delegation held that, while it supported a meeting of carriers on principles, it opposed the proposed agreement on grounds that the idea of an international organization had not been adequately delineated.

On an obvious reference to the CITA group, it further argued that the short-sighted intent of such a meeting was to seek to raise the air fare level established at Cannes. That, of course, would enable the CITA group to set the own rate level 20% below the IATA fares without creating a damaging depression of revenues. The U.S. delegation said it would support the new IATA fare levels as being the most reasonable and a minimum for fares in the context of its transportation between the U.S. and Latin America.

U.S. said it could not agree that a small numbers group should be allowed to control rates that has been approved by 95% of the world's international flag carriers. And the delegation said it saw no reason for a meeting of carriers to consider a third rate reduction from the present level, which is already under review. Such a level could be created without another carrier meeting, the U.S. argued.

During the course of the meeting, the majority of the governments took the position that the economic and financial difficulties plaguing Latin American nations were attributable to excessive capacity and that most governments now were anxious to expand some non-tariff over passenger traffic. As a result, the conference allowed these recommendations on the subject of capacity.

•Governments should provide positive

Lufthansa Reorders Boeing 720s

College, Germany—Lufthansa Germania Airlines has ordered four Boeing 720B jet transports, raising the total ordered to eight. Delivery is expected to begin next year.

The medium-range 720B will be used on Lufthansa's Seoul-Atlanta, New York and Middle East routes.

Lufthansa's jet fleet now comprises four Boeing 707-320s, with a fifth 720 scheduled for delivery next spring.

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portion over traffic to and from their respective countries through either enforcement of capacity clauses contained in various bilateral or transport agreements.

• Governments should adopt measures that will prevent as far as possible from generating capacity which is in excess of that considered adequate for basic traffic.

• Provisions should be made to permit governments to impose restrictions of eight frequency or establish maximum quantum of traffic on certain stock vessel capacity standards.

Colombia Condition

Colombia supported the recommendations on conditions that capacity restrictions apply only to traffic from country to country and not to traffic headed for third countries. The U.S. held that the experts issue was not of order as no one on the conference agenda was it required to consider such a condition. The agreement, however, could be in contradiction with the legal instruments under which U.S. experts are now serving Latin America. The U.S. also took sharp issue with the basic premise that a problem of excessive capacity now exists on routes throughout the continent.

In general, the conference of sessions devoted to capacity took on a strong anti-US flavor.

Recommendations were offered to impose restrictions on the volume of traffic that could be carried between our country to another. Such traffic, including Third and Fourth Freedom traffic, under the original recommendations would not exceed 25% of regional traffic. The recommendations also call for the exchange of traffic and destination traffic statistics to enable the governments to maintain adequate controls.

Venezuela Support

Venezuela supported the recommendations but reserved the right to exchange 10% of Third and Fourth Freedom traffic exclusively with another country. The U.S. went on record with strong opposition to the recommendations on grounds they were in complete conflict with U.S. civil aviation policy, providing for price increases and charged it was, has been signed by Western Airlines and the Brotherhood of Rail Way Clerks. The contract covers approximately 1,200 of Western's 2,578 employees in the railroad's communications other. The contract is effective from Feb. 1, 1960, to June 30, 1963.

The settlement provides for three-step pay increases, effective Nov. 1, 1960, May 1, 1961, and May 1, 1962. In addition, employees will receive retroactive pay for the agreement period from Feb. 1, 1960, to Nov. 1, 1960, the time that the new agreement was under discussion.

TCA, Canadian Pacific Revise Fare Structure

Montreal-Toronto Air Lines and Canadian Pacific Airlines are filing new North American traffic under a sweepingly revised fare structure that is based on a cost-plus principle linking fares to actual operating costs on various routes.

Developed by TCA, the new structure will make fare reductions on most routes, but will increase fares by 400 to 600 mil segments and stay the same under 600 mils from West Coast income. The new structure also will include increases of money otherwise travel as cross-border routes. Another innovation is seasonal excursion fares within Canada at a 25% reduction under the new regular fares.

Baggage allowances that will be liberalized. In the economy class, allowances will be increased from 40 to 44 lbs. An first-class service, the allowances will rise from 40 to 66 lbs. Extra baggage charges will be based on 6.5% of applicable economy fares, instead of 6.5% of first-class fares as determined at present.

The coming data fares will affect conjunctions with Eastern Air Lines on the New York-Montréal route and American Airlines on the New York-Toronto route. TCA has been offering only first class service to these routes, while Eastern and American both now offer each service.

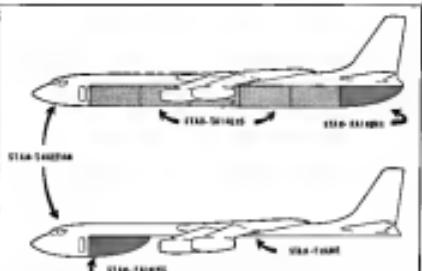
Other trans-border fares involved are Boston, Cleveland, Chicago, Detroit, Winona, Tampa and Seattle.

TCA and it has been waiting for a year as its counterpart and carrier for Douglas DC-3 jets and Vickers Viscounts to be delivered. The agreement applies to the new 10 North American routes to move at a per-mile tariff for each flight leg. Under the terms, TCA said, economies of long-haul travel will be passed on to the passengers. Fares on long short routes will not necessarily reflect the cost in the cost curve principle, but will come closer than at the past to meeting the actual cost of operations.

Trans-Canada has the new structure will result in lower unit rates per passenger mile, but the new fares should attract new volumes of passenger business.

With no surcharge on its jets and as federal transportation laws as in the U.S., New York-Vancouver DC-8s (via Vancouver-Toronto) will be \$313 round trip, or considerably lower than a \$2.80 jet fare of \$377.20 between New York and Los Angeles, according to TCA.

Toronto-Canadian's economy class seats in its DC-8 jet transports compare two-thirds of the total passenger capacity.



Freighter with detachable lower fuselage section would move fuel along length of aircraft to prevent weight transfer within cargo of freight cargo.

Cargo Aircraft Would Transport Pre-Loaded Modular Containers

San Gabriel, Calif.—New approaches to an all-cargo aircraft wherein pre-loaded containers are stowed under the craft's fuselage forming the lower body section are being developed by Hawker-Siddeley Aircraft, Inc.

Although the size of a detachable fuselage lower section is not now being fully determined on the Hawker-Siddeley HS-138 Pack Plane (AVW Nov. 13, 1959, p. 22), the STAR-Gulf Stream (Star-Trainer/Star-Freighter) differs in that it allows modular conditions of 10, 20, 30 or 40 ft. lengths called STAR-Trainer. These feature built-in the bottom of the plane never arrest and down the bottom corner of the fuselage where the cargo is being transported to conduct strength and rigidity. The forward fuselage section housing the new compartment would be at a configuration permitting a standard nose wheel arrangement. A STAR Trainer would be fixed immediately behind the entry compartment for door selection and deadhead missions without the STAR-Trainer or would be carried as a forward part of the last of the modular STAR-Trainers.

According to Hawker-Siddeley, components of existing aircraft such as wings, fuselage, forward fuselage sections, landing gear, engine, etc., could be used and the idea is equally adaptable to turboprop or reciprocating propeller aircraft.

Such a plane never aircraft is intended to fit a STAR-Trainer and while the wings, fuselage, engine, etc., are common to the plane of the components comprising the flight parts of our aircraft."

CAB Blames Accident On Missed Approach

Washington—Failure of an Allegheny Airlines pilot to complete a missed approach procedure was cited by the Civil Aeronautics Board last week as a probable cause of the crash of a Martin 2-21 Dec. 1, 1959, near Wilkes-Barre, Pa.

As an overriding factor, the Board noted in the inquiry that the aircraft flew from a compass heading indicated as 270° by a crew member while the transport was in a right bank attitude. Internally duplicating this attitude was in the banking condition produced a compass error of up to 70°, which Board investigators say could have accounted for the aircraft's sharp departure from final approach and crash into Bald Eagle Mountain more than a mile south of the airport. The crew of three, an additional crew member, and 22 passengers were killed.

Capt. Thomas R. Collyard, 31, was in command of Flight 371, a regularly scheduled flight between Harrisburg and Wilkes-Barre, with copilot George M. Bowen, 30, and with an additional cockpit, Donald W. Tygart, 26, occupying the jump seat.

Under weather conditions of scattered clouds with a 2,000 ft. ceiling and visibility of 1.5 mi. in light rain, the flight was cleared over the airport at about 9:45 a.m. in an effort to land to a height to allow a landing the accident report said. After this initial approach, the aircraft was observed to fly over the field and then make a right turn for a circling approach to runway 32.

However, as the aircraft appeared to complete the turn, it was seen to roll out of a right turn and into a left turn and by toward the south in level flight, finally disappearing into low clouds and clouds, according to the Board.

Board investigators came to the conclusion that because of the location of the engine, which is in the middle of the aircraft, and at a low level, coupled with the lack of any ground for this aircraft, it was left exposed to considerate movement by any passenger occupying the jump seat.

With the resultant incorrect compass reading, Capt. Collyard probably was led to believe he had passed his landing and immediately turned left to a new heading, the Board said in its report.

Immediately after leaving of the possible effect of accidentally caging the rudder controls, Allegheny installed guards on instruments in the rear cabin in an effort which had similar results.

Jet Engineer Fatigue Problem Reported

By Robert H. Clark

Washington—Greater fatigue is a mounting problem at the airlines due to jet operations according to preliminary results of a Federal Aviation Agency study of flight engineers.

During their findings on cut-throat physical endurance of 20 flight engineers, two physicians working under FAA contract have submitted a report indicating that mental and physical fatigue are a definite problem. They said it may be directly related to increased crew responsibilities, irregular flight schedules and increased flight duty time.

Study was made over a three-month period on 20 engineers assigned to domestic and international turboprop transports. The doctors have recommended that FAA expand this type of study to include more engineers working under a greater variety of conditions.

fatigue analyzed

FAA is still analyzing answers from a questionnaire sent to a random group of 100 flight engineers assigned to 90 turboprop transports and 66 interjet transports. This fatigue questionnaire was prepared earlier this year at meetings with the Flight Engineers International.

Pilots and other crew members were

not included in the survey because the most fatigued complaints were filed by the FEAs, FAA said, but the results obtained could reasonably be expected to apply to all jet crew members.

This gives the selected 20 engineers included a three-hour physical at the beginning of the experiment, along with examinations started 90 min after the engineers completed their post-flight maintenance programs. Some of the tests included a personal medical history, laboratory tests, X-ray studies, electrocardiograms, blood pressure, blood counts, urinalysis and blood sugar tests, along with neurological, psychometric studies to evaluate nervous system and ability to think under stress.

Two of the group flying international routes were examined by Dr. L. I. Statman, of the New York University Medical Center in New York, and the balance assigned to domestic routes were studied by Dr. Bruce V. Lewin in Los Angeles. Both flight physicians noted similar complaints from the engineers, who noted a great difference in fatigue between passenger and jet-engine assignments. The engineers reported that fatigue on jets became most noticeable after about 100 hours of flight.

Dr. Statman reported that his group found they have been forced to spend more time on duty to log their average 85 hr monthly flight time, with

the result that the engineers have forced themselves spending more time at home and getting sufficient rest before routine flights. In addition, they complained that the jet's high speed and schedule flexibility has disrupted their sleeping habits because of constant flights through changing time zones, and has also subjected them to health hazards as a result of trips which often involve trapped and toxic gases within a minute of hours.

While electrocardiograms, X-ray and urinalysis tests on these men failed to detect any physical changes, the doctors and further tests on the flight engineers showed that fatigue and sleep deprivation within the flight engineer indicated a "definite trend of items unusual for men of their age."

Higher Cholesterol Levels

Noting a "marked and obvious difference" in the cholesterol level of the 20 flight engineers, compared with 18 average men of different occupations tested over a decade, Dr. Statman reported the flight engineers' level tested at 200 milligrams, or 25% higher than the average reported 213 milligrams for men in the same age levels but different occupations.

Dr. Statman also found that fatigued deposit within the engineers' bloodstream were considerably above normal, with a test reading of 355 milligrams compared with the usual level of 318-340 milligrams.

Analysis of the test information seemed to indicate a trend between fatigue and total blood cholesterol, the doctors said, but noted proof of this theory would require a second physical study of flight engineers compared to less fatigued schedules for comparison purposes.

While Dr. Lewin said that he would not determine the medical cause for fatigue among the domestic service flight engineers in his group, he said that their fatigue was "undeniably due to increased tension resulting from irregular flight schedules and a lack of proper rest between flights."

With the New York group, these engineers also complained of inability to regain their vigor after 3-4 months of jet duty and pointed out that they seemed more tired after 4 hr of turboprop flying than they previously had on passenger aircraft flights of more or more hours.

While most flight units with their monthly flight time limitations of 90-95 hr, Dr. Lewin and they were unanimous in recommendation of schedules which they contend have forced them to spend as high as 275 hr on duty

a month to log their flight time. Pilots spend duty, in comparison, usually partitioned 1-day rest between flights, while pilots of the two survey groups often flew that long for rest, the engineers complained.

Dr. Lewin noted that the duty time required for the engineers to earn their flight time on turboprop transports is approximately 180 hr a month more than would be otherwise required to reflect their salaries.

FEIA officials say they would like to see the flight engineers' monthly duty time reduced 180 hr a month in order to bring their monthly salary closer to those of the other cabin crew. FEIA says this would be undertaken with a 25% age group which has been forced from passenger to turboprop aircraft and with a second group having only jet experience.

not that on a passenger-cargo schedule from New York to Frankfurt, Germany, flight engineers accumulate 30 hr, flight time in 72 hr away from home. The same cabin crew schedules with turboprop crews the engineers less than 17 hr flight time for the same 72 hr period.

Flight engineers maintained by Dr. Lewin ranged down the age of 38 to 65 with average flight experience of 19.6 years 1.3 years of jet experience. Below are detailed conclusions of the survey of flight engineers:

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business. Since the competition of the supersonic jets has increased, there seems to be fewer and the rate has not gone up to MATS will skyrocket further.

"The large flag carriers do not really want to compete or negotiate for group," he added. "But we are placing the military route as individual routes in their regular route flights at 65% traffic at high commercial rates subject to relatively small military discounts. At this stage it is needed with the rest of the CAB, the soldiers become a premium customer for commercial."

Burrell estimated that the military can increase revenues from the new 2.9 cent fare would supplement \$36 mil annually for plane load transports as compared with the same than \$122 million for individually ticketed passengers, which supplements are now authorized to handle.

Airline Efforts

Efforts of using flag airlines to partly meet the military for a route model, the military requires a regular civilian fare was encouraged by CAB action protecting their update as possible interjet routes, and encouraged to group the system a "bullet" jet plan and increasing their leverage with the Department of Defense," Burrell charged.

One legal dagger of the proposal, he said, was a provision calling for a notice notice for cancellation. To either the participants or the government, the latter could hold the funds and obligating the government to a two-year period even though a new Administration might come to terminate the contract, he said.

Outlining the growth needs of the supplemental airline Burrell had particular issue with CAB regulations limiting the carriers' charter flights to regional areas that are limited to passenger service and fewer destinations than were granted in the past two years.

"It is of course, obvious that with a route, virtually, all carriers will bid for the route," Burrell said, "and because of equipment performance, the large carriers will become virtually all of the route."

United Jet Financing

United Air Lines is seeking negotiations with the Securities and Exchange Commission for a \$25 million issue of convertible debt, which would include options to purchase bonds by Hawaiian Airway Co. (AW 04-11, p. 82).

Initially the bonds will be used to reduce existing bank loans, but the long term goal is to meet United's need for equity capital for financing its series for Boeing 727s, for the Capital Airlines merger, and possibly for a Boeing 727 order.

WHAT'S IN YOUR AIR CARGO FUTURE...

PROBLEMS? OR PROFITS?

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with efficient economy and timing ability. The Canadian Forty Four will do this for you. It can follow the air-cargo feeder lines with the long-range aircraft to provide a standardized containerized diet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shipping, are being forced to diversify a route pattern to include both long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this instance, the Canadian Forty Four offers excellent economy and carrying ability over the complete range of route structures that can be provided in the collection and distribution of air cargo.

SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FOUR-D4

- From runways as short as 6,000 feet, can operate with 30% payload up to stage distances of 3,000 miles.
- Can operate from 60% of the world's major airports, with due consideration to both runway length and allowable wheel loading.
- Will earn an operating profit with load factors as low as 30%.
- Round-trip load factors in the Forty Four represent low loads on larger proposed equipment.
- Round-trip load factors as large proposed equipment represent major profit payloads on the Forty Four.
- Can operate non-stop on the London-New York route with an average netted payload of over 55,000 lbs.

CANADAIR LIMITED, MONTREAL, CANADIAN SUBSIDIARY OF **GENERAL DYNAMICS**

in the waiting zone. "Excuse me, but I wish this sort of pilgrimage open you for your indifference."

• "I am indifferent to the depths of my soul at the silliest attitude toward passengers."

The writer points out that many passengers are won by information from a person to catch a plane at Vnukovo when it actually leaves from Sheremetyevo or Bykovo, a third Moscow airport which was to have been built down 18 years ago but became a terrible mess in that period of 10 times the volume handled in 1950.

They emphasize that there are no accommodations for only 452 people at the hotels of those airports and that passengers spend in much time waiting for baggage on an open on the tarmac from Kiev to Moscow.

They concluded that the "technology

of the sky is not lagging" but added: "A variety of growing problems, solutions to which are not yet developed on Aeroflot's staff, are holding back the дальше, the heading toward成熟 of this sky technology. These problems must be solved and as soon as possible. Fulfilling service on the ground must be as keeping with the highest perfection in the sky."

Los Angeles Studies Future Airport Needs

Los Angeles Comprehensive study of the future airport and aviation requirements for Los Angeles and the surrounding area has been started with Stanford Research Institute appointed to conduct a study of the information needed to determine the long-range further required.

Cost of the study may reach \$100,000 and will probably be supported by the Horace Foundation and the Southern California Improvement Foundation. The study will cover diversified area including the Los Angeles County, Orange, Riverside, San Bernardino and Ventura counties.

Purpose of privately financing the study by the two nonprofit foundations is to eliminate the possibility of special interest groups or private financial groups getting any special consideration in respect to airport placement. Scope of the survey will cover military, commercial, private and business aviation as well as passenger and freight traffic for commercial airlines. Each phase of operation and other studies Stanford's preliminary study is scheduled to be completed in January, 1963.

Analysis of the preliminary study will make it possible to determine the more cost of further research required and the most effective course of action which the research sponsor might follow in subsequent research.

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Gold Brand vacuum tubes, resistors and small power type tubes are all available promptly from your Sylvania Industrial Tube Distributor. Try him. Ask, too, for your copy of the Sylvania Gold Brand Tubes brochure. Or, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 1011, 1103 Main Street, Buffalo, New York.

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This order follows induction by UAL of the Caravelle
Flight Simulator which Redifon recently delivered to S.A.S.

REDIFON LIMITED FLIGHT SIMULATOR DIVISION - CHAWLLEY SUSSEX ENGLAND
A Manufacturing Company in the Redifon Group

Airline Traffic—September, 1960

	Revenue Passenger Miles Flown	Revenue Passenger Miles Flown	Load Factor %	U. S. April Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Passenger Miles	Over-all Revenue Load Factor, %
CONTINENTAL U.S. AREA								
American	205,000	241,227	44.4	1,161,519	7,100,299	45,280,443	45,4	
Brown	105,361	122,476	41.2	681,257	142,109	3,227,723	41,4	
Capital	111,143	132,286	44.8	604,958	239,191	3,020,743	39,485,109	77.2
Continental	116,526	97,829	39.6	216,213	134,258	300,099	39,376,821	60.3
Delta	207,148	216,281	43.2	1,049,783	342,154	4,810,484	46,125,379	71.4
Eastern	680,209	217,323	32.48	1,195,395	20,514	2,124,242	41,209,203	41.4
Frontier	134,403	48,034	48.2	378,256	72,878	816,144	7,201,243	38.5
Interstate	111,148	111,261	40.8	114,293	42,109	2,101,207	4,166,109	42.3
Midwest	101,200	129,270	44.2	500,200	10,200	7,200,000	43,447,200	33.4
Trans World	694,369	411,264	39.4	3,845,618	804,846	4,615,099	48,947,200	33.4
United	216,560	216,281	46.8	8,937,720	1,360,098	7,077,254	50,271,700	50.1
Western	120,302	75,138	49.6	311,649	79,255	225,697	6,384,179	49.6
INTERNATIONAL								
Aeroflot	8,214	8,297	52.9	4,424	684	377,159	8,193,779	30.4
Aeroflot	8,213	11,228	39.2	3,477	1,277	327,200	11,704,200	40.8
Aeroflot-Atlantic	27,056	1,177	39.9	1,367	—	7,470	29,623	44.8
Delta	1,194	2,150	39.8	3,120	—	30,310	30,490	71.5
Eastern	99,195	28,458	31.28	30,410	—	236,040	5,797,339	49.18
Frontier	5,121	3,140	40.2	1,320	—	9,111	21,600	41.5
Interstate	17,661	83,959	47.6	1,297,303	14,324	1,277,310	4,306,044	35.6
Interstate	4,233	4,277	50.0	2,676	—	167,617	1,195,267	41.2
Aeroflot	102,583	206,440	45.7	2,101,471	4,446,447	30,221,894	47,221,894	44.8
Trans-Airline	90,601	171,440	64.1	4,271,491	4,154,594	15,481,184	39,999	69.9
Trans-Airline	41,127	130,706	70.9	3,173,163	3,123,402	16,461,193	38,615,402	69.9
Transavia	91,105	16,271	22.7	36,240	—	401,581	401,581	33.1
Trans-Caribbean	35,476	120,744	64.1	1,426,974	8,122	1,299,723	12,474,102	64.4
Trans-Caribbean	17,477	40,293	50.7	235,967	8,122	111,273	4,427,448	53.3
Trans-Caribbean	8,209	3,833	23.9	7,706	—	21,784	401,581	53.3
UNICAR SERVICE								
Aeroflot	67,343	15,643	46.2	34,493	86,219	27,188	1,424,859	48.9
Aeroflot	33,454	12,293	36.6	4,121	6,030	10,201	33,454	36.7
Aeroflot	14,459	12,293	43.8	9,019	6,030	10,201	33,454	49.9
Aeroflot	20,320	8,124	40.8	9,474	5,071	46,819	46,819	46.2
Delta Control	26,219	2,164	40.8	6,120	30,493	495,190	46.2	
Aeroflot	64,073	11,397	46.8	31,426	32,831	33,208	1,143,943	42.8
Aeroflot Control	14,459	12,293	47.9	29,003	26,054	31,428	1,143,943	49.9
Aeroflot Control	54,333	8,123	42.7	11,148	32,863	31,428	991,941	44.1
Frontier	43,327	6,496	46.4	10,756	14,549	39,345	706,477	33.1
Frontier	30,514	5,710	39.7	12,173	11,314	12,173	482,321	33.1
Frontier	26,214	8,123	48.8	14,355	3,783	34,999	460,311	49.6
IRISH AIRLINES								
Aer Lingus	38,813	4,415	36.9	2,322	—	8,446	245,311	47.6
Aer Lingus	46,871	8,116	64.1	12,779	164,313	986,084	46.8	
CAIRO AIRLINES								
Aero-Indonesia	3,363	8,611	29.8	40,993	84,000	4,406,355	486,355	75.2
Brunei Airways	1,119	116	24.2	6,927	12,994	8,486,486	8,486,486	77.8
Brunei Airways	79	300	26.8	3,865	—	7,493,707	3,446,393	67.6
Brunei Airways	1,112	2,767	38.8	—	—	3,016,314	3,016,314	64.6
HOLOCOPTE LINE								
Caribbean Interislands	91,269	485	49.9	1,233	—	47,270	47,270	46.7
Caribbean Interislands	9,119	116	24.2	6,927	3,214	7,493,707	75,000	63.3
New York Airways	11,199	323	32.3	1,316	478	563	57,001	56.4
ALASKA AIRLINES								
Alaska Airlines	12,656	10,141	33.8	73,397	4,377	420,548	1,431,177	47.4
Air-Carrier	8,210	623	38.8	3,958	—	5,334	79,449	48.4
Caravan	1,119	504	38.8	1,419	—	4,459	47,270	46.8
Ed	4,449	2,099	38.8	2,125	—	5,324	47,270	46.8
Midwest Consolidated	2,411	772	38.8	41,452	—	29,273	289,492	41.3
Midwest Consolidated	19,349	11,167	32.3	334,449	10,320	413,168	1,741,178	47.8
Midwest Airlines	417	60	37.0	352	—	1,833	4,154	43.6
Midwest Airlines	2,015	1,252	38.8	47,270	—	47,270	261,313	47.6
Midwest Airlines	1,000	348	48.1	326	—	410	84,766	44.9
Airlines Air Transport	16,327	348	48.1	326	—	410	84,766	44.9

*Not available. **No operations this month. ***Data presented by the board as records destroyed by fire. Compiled by Airlines Week from other reports in the Civil Aviation Yearbook.

BULLETIN FROM **BOEING**...

...WHERE CAPABILITY HAS MANY FACES



Minuteman, the nation's first solid-fuel ICBM, blasts from underground silo, left, in tethered firing test. Successful Minuteman firings cut test program, saving millions of defense dollars. Boeing is weapon-system integrator of the 6000-mile-range Minuteman missile, now under development.



FLYING COUSINS. You can earn a continued or immediate living by flying planes, then fly to local airport or eventually in a helicopter built by Boeing's Vertol Division. Vertol helicopters are flown by the U.S. Air Force, Army and Navy as well as by the commercial carriers and armed services in many countries. Boeing 747s and 720s—most powerful aircraft in the world—have already carried more than 10,000,000 passengers.



HOTSHOT TUNNEL. Here, the largest privately owned wind tunnel facility in the world, Boeing aircraft, missile and space vehicles—models up to 1/10th scale—travel at 35,000 miles an hour. Many trans-flight conditions can be simulated during tests. Decades of emphasis on research have enabled Boeing to pioneer nation-benefiting advances in vital areas of machine and human flight.



RAGGED TURBINES. Boeing gas-turbine engines power the high-speed 60 company passenger jets as well as U.S. Navy maneuvering launchers and landing craft. Light, powerful, compact Boeing shaft-drive turbines have served many fields: first turbine to power highway truck, fire engine, helicopter, locomotive and flight airplane. Boeing turbines also serve in jet-powered starters used by U.S. Air Force and commercial aircraft.

BOEING

407 AIRCRAFT, MISSILES, HELICOPTERS, TERELINE, WEAPON-SYSTEM MANAGEMENT, SPACE-FLIGHT VEHICLES AND SYSTEMS.

AIRLINE OBSERVER

► United Research study on international civil aviation policy (IAW June 14, p. 38) was scheduled to be delivered to the White House late last week.

► French government has stepped into the dispute between airlines and jet air crews over working hours. Government has ruled out flying for crews should average 72 hr. monthly. In addition, crews on long jet flights are required to have at least four consecutive days off each month. Crews were holding against airline attempt to keep them working on jet routes or limit at the same place in one piston aircraft.

► Air Line Stewards and Stewardesses Assn. attempt to drop its affiliation with the Air Line Pilots Assn. is being resisted by the AFL-CIO, which feels the two-airline agreement should be settled internally. ALSSA has filed a grievance against the stewardesses' charters and AFL-CIO President George Meany has urged the pilots' union to drop a suit filed against the stewardesses since after ALSSA moved from ALPA headquarters. As a result of Meany's personal intervention, ALSSA and ALPA officials met in Washington recently to discuss their differences.

► Federal Aviation Agency has reauthorized its bird control program at Wade良良 National Airport. Coated tower operators, operations officers and airport police are under orders to constantly start vigilance for unusual bird or wildlife activity at all times. Advances information on bird activity will be issued to pilots, and general staff will be encouraged to assist in bird and conurbation when areas listed will be cleared of displaced birds. Shooters will also be encouraged to assist birds without trapping them. Consultation with Fish and Wildlife Service experts, Smithsonian Institution officials and Audubon Society members will be held to determine other means of controlling bird flights at airports.

► Trans World Airlines' experimental use of Edi Loran and doppler navigation aids is drawing bury from the Transair Warsaw Union, which fears use of the equipment may lead to eventual displacement of TWA navigation. Union spokesman complaint that installation of the system in the central panel of one TWA Boeing 707, instead of at the navigator's station, has resulted in the captain taking over steering navigational duties in transatlantic flights.

► Federal Aviation Agency has issued an order specifying that contracts negotiated by the agency in which FAA supplies pass on all of the funds must include a provision under which a law clause of the rights to data and patents will be retained by the government. Clause is to be in reasonable proportion to the respective contributions of the agency and the contractor.

► Number of tourists leaving United Kingdom by air exceeded those traveling by sea for the first time during the first six months of 1969.

► Pan American World Airways still is interested in a larger, turbofan-powered Boeing 707 though it has failed to go ahead on a version designated the 707-320. This engine would have a longer landing and an increased range of 1,000 miles. The Pratt & Whitney JT3D turbofan engine, now is reported as a mounting block.

► Export-Import Bank of Washington has extended a \$14 million credit to TMA, independent French airline, toward the purchase of one Douglas DC-8-100 jetpassenger transport. Total cost of the airplane is \$6.8 million, including equipment and engine parts. TMA will pay about 65% of the cost in advance, with Douglas Aircraft Co. financing the balance of \$500,000. Pan American Shipping Corp. of New York will participate in the Banknote credit to the extent of buying early subscriptions in the amount of \$773,000.

► Words for a move by El Al Israel Airlines to expand its routes into Africa. Israeli government delegation is now conducting talks on possibilities of negotiating bilateral air transport agreements with Ghana, Liberia, Nigeria, Mali and Senegal.

SHORTLINES

► British European Airways is planning to start service to Belgrade Aug. 1. The route, which has been requested by the British and Hungarian governments, BEA will serve the Hungarian capital twice weekly by extending its London-Prague flight. Monday and Thursday Vickers Viscounts 860s will be used.

► British Overseas Airways Corp. is using de Havilland Comet 4s removed from transatlantic service for its London service to the Far East and Australia. The British carrier has increased its London-Singapore service from two to three flights weekly and London-Australia flights from 12 to 13 flights weekly. BOAC has been operating London-Kinshasa service with the Comet 4 and is operating a twice weekly service from London to the British Gulf with Comets 4s for its associated airline, Middle East Airlines.

► Civil Aviation Authority has granted permission to Eagle Airways (Bermuda), Ltd., and Eagle Airways (Bahrain), Ltd., to operate jointly under the same Civilian Eagle Airways. Control Stress Stop Co. recently acquired control of Eagle and wants the carrier to operate with the Civilian name.

► Federal Aviation Agency will retain L. W. Deeter as Director of Washington National Airport, Berlin, on leave of absence for the past few weeks, had been acting director of the Bureau of National Capital Airports as well as director of Washington National until the appointment of G. Ward Hobbs as director of the bureau.

► Northwest Airlines has begun daily transpacific flights with Douglas DC-10 aircraft. It also is operating a service by a series of flight requests, beginning by the International Air of Macau, which has grounded Northwest's fleet of Douglas DC-8 interjet transports. The airline formerly operated four DC-8 round trips weekly and three DC-10 round trips weekly between the U.S. and Far East.

► Trans World Airlines has started three new all-jet flights this month using the new Lockheed L-1011 aircraft. TWA began service with weekly New York-Shannon-London-Frankfurt flights. The airline formerly operated eight New T. 10s, making a total of five flights weekly. A new daily New York-Los Angeles-San Francisco flight was introduced for Nov. 10. In addition, TWA was scheduled to begin daily service from Philadelphia to New York, Chicago and Los Angeles Nov. 18.



Could you pick the guilty part?

Professional engine busters say there's no such thing as looking like a criminal. And it's much the same with replacement parts. A bargain price on substitute often resembles the original so closely that even a master sleuth would be hard put to find a single clue to prove the difference. But that doesn't take your engine long to detect any hidden weak spots. And right then, instead of saving money, you may face charges for costly major repairs.

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count on their quality. It's assured by precision processing and rigid quality controls. Through research, refinement and testing, they are constantly improved to match the requirements of improved engine performance. Without access to these improvements, no substitute is likely to measure up to the high standards of dependability engendered into Pratt & Whitney Aircraft engines.

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Longueuil, P.Q., Canada



CONVAIR 88-7 proposed supersonic transport configuration would be aluminum alloy aircraft to operate at Mach 2.4 cruise speed. Capacity would be 52 passengers and range would be on the order of 3,800 miles with reserves.

B-58A Proposed for Transport Research

National research program based on the B-58A heavier and armed at establishing design requirements for supersonic and subsonic supersonic transports is being prepared by Convair Division of General Dynamics Corp.

Major advantage of the program at a national level is to fill the time gap between now and 1965 when the North American B-70 begins to stimulate Mach 3 flight hours. Convair's program would parallel the B-70 project and should be expected to produce data supplementing that coming from the B-70 flights.

Advantage to Convair is that the program can exploit and extrapolate its current heavier B-58 flight experi-

ence at Mach 2 to strengthen its competitive position in the race to a Mach 3 transport, the general goal of the Association of American aircraft now is the running.

Three-Step Program

Convair's program is the easiest, fastest and cheapest way to get operational experience with an airplane establishing a supersonic transport. Its study of the B-58A heavier currently is the only one available capable of maintaining supersonic flight at Mach 2 and has also a U.S. lead in this transport program.

• Existing B-58A would be converted to aero-elastic routes of supersonic

speeds working to the range from Mach 1.3 to 2.8. This phase of the program would provide an engineering and operational foundation for solutions of numbers of problems, including with respect to altitude as support operations on the ground and in the aircraft are with traffic control, sonic boom and handling characteristics consistent with passenger-carrying operations. Part of this step is already scheduled by National Aeronautics and Space Administration's Langley Research Center, operating out of Edwards AFB. NASA plans and techniques will investigate the handling characteristics of the plane in simulated commercial use. They will study all flight phases from takeoff through landing, with side replacement into critical problem of ATC, integration, research and clearance.

• "People-pod" with room for five passengers and test instruments would be carried in the B-58A as the second stage of the original. Purpose would be to examine the operational potential in the normal environment of a supersonic transport cabin. One example: Poling load power density at Mach 2 cruise produces a 0.7g deflection far above the level produced in the most severe normal acceleration of banking and thrust reversing. Convair says such a modified B-58A could fly early in 1965, and would require about \$7 million in program cost.

• B-58 transport, model configuration 389, would be designed and built in a fast quantity of a dozen. This design,

AVIATION WEEK, November 14, 1960



PROFILE FIG. 10 existing B-58A heavier would enable conversion to obta a heavy-duty aircraft for supersonic flight.

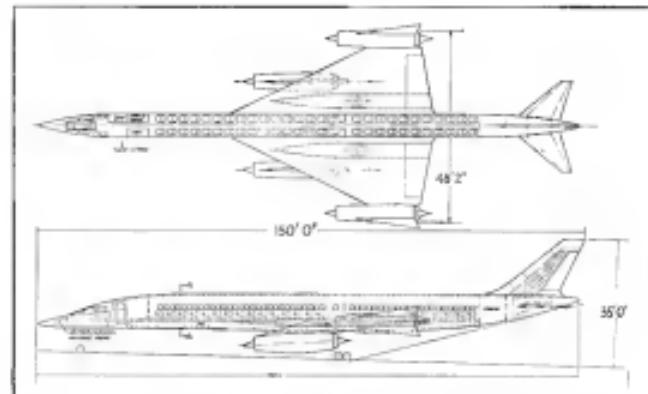


FIGURE 10: Convair 88-9 proposed strategic bomber proposal, modified to make the layout suitable for a supersonic transport. Horizontal tail has been added and landing gear retracted for cabin space.

draws on the most already done. In the company is proposing a B-58C representation version in Strategic Air Command, would be powered by four Pratt & Whitney J58 turbojets rated at 18,000 lb. thrust each without afterburning. The 85.9 ft. model carry 52 passengers in a conventional cabin. The maximum range factor of the B-58C operational speed would be Mach 3.4. The envelope would be oblique air structure as opposed to the transonic airfoil of the B-70. Convair program data call for a first flight in 1965 and a total cost of about \$300 million for design, development, production and testing of the 12 aircraft.

The last step according to Convair engineers, would provide the final lots of data needed to determine the real requirements for a supersonic transport. With a dozen such aircraft flying in and out of commercial fields and operating on the world's airways, the key value parameters of subsonic economy, transonic maneuver and supersonic performance could be pinned down early and in a short overall time cycle that would meet the requirements of a 1970 transport aircraft.

An analytical review of the 18-9 transport proposal shows stepped climb to initial cruise altitude just under 60,000 ft. and propulsive ascent to altitude due to fuel burnout. Cruise speed would be Mach 2.4 at 95% military power. Reserve would be about 10% in altitude at profile.



MISSION PROFILE FOR 18-9 supersonic transport proposed shows stepped climb to initial cruise altitude just under 60,000 ft. and propulsive ascent to altitude due to fuel burnout. Cruise speed would be Mach 2.4 at 95% military power. Reserve would be about 10% in altitude at profile.

design and modified it to meet these modified requirements for a supersonic transport. These requirements were developed by computer techniques which used large performance data to develop performance for a family of aircraft meeting wide ranges of speed and range performance. The "18-9" profile was continuously cycled through the computer to produce a series of optimum results for any given set of requirements. Convair believes that the 85.9 is the optimum supersonic transport, but would do believe that it is the best supersonic transport that could be made feasible in a short time span.

Cabin interior

Cabin interior of the 18-9 features a series of single seats of the type used on the Convair 880 and 600 transports. Seats are in a 3-in. pitch, and the aisle width is 18 in. between seats. Total capacity of the cabin is 52 passengers. Basic performance calculations show a Mach 2.4 cruise speed (3,775 kt) and a 3,530-mile range.

Cruise speed for the range is 1.014 kt. Time for the trip figure to be 2.41 hr. Reserve usage at the terminal is 9.5% fuel.

At a takeoff weight of 190,000 lb., the 18-9 would require a field length of 6,500 ft. and would lift off the runway in 19.4 sec. Landing would take a half-mile field length of 8,780 ft. At a



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a technical-staff of over 300 devoted exclusively to solving inertial guidance problems. Our engineering experience includes work with air-bearing gyroes that float both gimbal and spinning mass, as well as with liquid-fueled gyroes and accelerometers. Guiding specialists have developed the way to mass compact inertial guidance platform packaging.

The point is this. With demonstrated production accomplishments—plus practical design and engineering experience—we offer a range of proficiency to apply to your inertial guidance needs—whether they be for space, space or under the sea. Why not explore our capabilities? A word from you will bring our experts to your desk.

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For pre-packaged storable missile applications...long term storage of corrosive, exotic propellants. Zero leakage. Light weight. Reliable.



This latest advancement development by the Components Department of RMD is answering critical plumbing problems in more sophisticated space and aerospace missiles.

Hermetic barrier valves combine particulate sealing capability of bellows with low pressure drop of butterfly valves. They are designed for use with storable propellants—cryogens such as hydrazine, dioxane and other hard-to-handle fluids.

Practical pressure returns these valves which are fine-driven to full open position. Solenoid-powered and solenoid-triggered types are also available. Sizes 1/2" to 10". Reciprocating hand-motors or motors with clutches and hermetic butterfly elements allow all closure of free particles entering propellant streams.



HERMETIC TYPE DISCONNECT VALVE. Solenoid or pneumatic actuated hermetic butterfly valve. (1/2" to 10" sizes.)

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Components Dept.

initials speed of 148 kt, and landing weight of 11,222 lb.

Cessna now estimates that the 159 could be flown with a direct operating cost (DOCD) of 2.5 cents per seat mi. The total price out to \$2,698 per passenger flight hour.

Program Timing

The Cessna program for the 159 configuration assumes that the order to go ahead will be given for January, 1981. First flight would be 13 months later in October, 1985. First four airplanes would be put through a company flight test program lasting 18 months, while FAA, NASA, and DOD would evaluate these airplanes for a 15-month period.

Subsequent commercial operations would begin in March, 1984 with MATS flights during the operational check-down, and by October that year the 12 airplanes in the program would have accumulated 2,900 total hours of operational flight time.

Initial rate of spending called for is \$21.5 million the first year, increasing to \$19 million the second and \$18.7 million the third, during the course of extensive engineering design and development. Total production would begin in 1985, spending the first year for 14.5 million in production and test (continued in parallel), and in the fifth year the program cost would be down to that required to support the airplanes in their operational role. That figure is currently estimated at \$3.75 million.

Program Benefits

Cessna argues that everybody in the business would benefit from the 159 program, not just its aircraft company partners. The 159 represents the joint NASA/Dept. of Defense project that produced the X-38 series of research aircraft to benefit industry across the board, and the helicopter development operations conducted by Military Air Transport Service's 176th Test Squadron (Tuskegee) which did a fast 10,000 hr of flight test with relatively unproven components with the general benefit of operational experience for everybody to benefit.

Practical bonuses to industry, the air lines and military and civilian agencies would be produced by the program, the company says. For instance, the airplane could serve as a payload test bed for a variety of engines, producing impressive cost data for engines without afterburning. It could provide strength and materials data under conditions of hard-coupled structure, and answer a variety of questions in the design of aircraft, missiles, and other vehicles under extreme temperature conditions.

For the airlines, Cessna's program would provide the answer to one of the operational questions before the customer had to commit themselves to



Bell HU-1A Helicopter Instrumentation

Dashboard details of the Bell HU-1A, known as the Army's aircrew instrument system (AVC). Oct. 27, p. 146, are outlined in this photo and during. Instrument panel sits on right side and has radio controls at his left hand. Seats are positioned 14 of the training heli division in the Army Aviation School. Ft. Rucker, Ala.



Instrumentation panels: (1) altimeter (2) attitude indicator (3) windmill indicator (4) fuel indicators (5) rate of climb (6) radio magnetic indicator (7) turn and bank indicator (8) clock (9) compass indicator (10) torque meter (11) per cent fuel indicator (12) exhaust heat position (13) fuel gauge (14) fuel pressure (15) engine of temperature (16) oil pressure (17) transmission oil temperature (18) transmission of pressure (19) dc voltmeter (20) fuel meter, main pressure air voltmeter (21) fuel series, auxiliary pressure (22) auxiliary control. Quick release knobs close instrument hood from waistfold.

THRUST VECTOR CONTROL BY
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Use of enriched propellants, with consequent high gas stream temperatures, has emphasized the reliability, performance, and weight advantages of secondary injection thrust vector control. Moog has developed liquid secondary injection control with outstanding momentum recovery, unique direction and penetration characteristics. The experience gained in the design, manufacture and use of these system components is unique competency.

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LEADING INNOVATOR AND PRODUCER OF ELECTROHYDRAULIC SERVOVALVES

Reducing out the load was through the introduction of new equipment.

For the military, there would be technical benefits to add to background knowledge for superior aircraft design.

For the Federal Aviation Agency, the Convair program would help solidify thinking and theory into Faa requirements for superior flight standards.

Convair wants such a program to be jointly sponsored by those of the agencies to derive benefits from it. Faa, NASA and the Air Force.

Admittedly, all the costs of this program are not obvious. Convair's Ph. Werth plans will run down an 8-90 production and the company's expenses to go with the Model 580 and 680 following, plus an uncertainty over the Model 60, unless it is two years or a portion of it is to be a supercruise transport project on its own.

Sparkeen says other segments of the American aerospace aircraft industry agree that no company is in a position to tackle alone the costly job of design and development of a supercruise transport. This left the world market at too small and the necessary pricing to the airlines too high even if the entire cost were covered by a single company.

Cooperative Development

Cooperative development is one proposed method now being tried in both England and France. But Sparkeen doubts that any coalition of U.S. companies could cooperate on a joint commercial aircraft.

Lacking that, the only method seems to be an outright subsidy for development, either in the form of an order for a specific aircraft from the military, or in the form of the kind of program presented by Convair.

Any company would hope for both to happen, but with the military still negotiating the subsonic jets and apparently not eager to commit too much of its money for transports anyway, any specific order from that quarter seems far off.

Even if Convair gets that program through, it will still face strict testing (1965) with a heavy load of static and flight experience on a Mach 2.4 transport which, in its own admission and general agreement among competitors, is the wrong speed for a supersonic jet liner. Convair will also be facing the heat face of several hundred hours of flight time—certainly including some at Mach 3—on 670 prototypes in three years.

Convair is basing its program on the hope that progressive development through the supersonic range, with more complete understanding of the problems at the way along, will be of greater advantage than plowing straight into the Mach 3 speed range. ♦♦♦



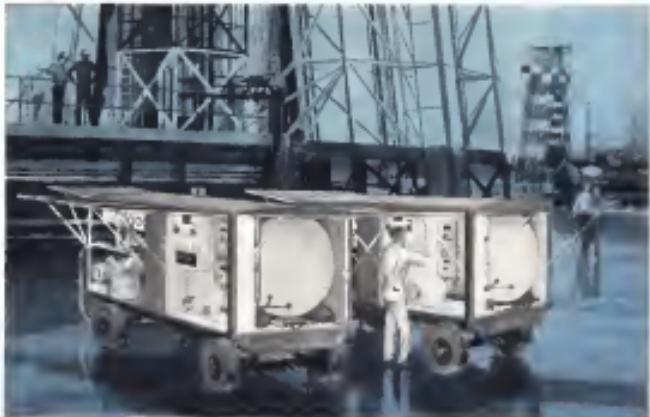
Acceleration and high shock

Testing, before trigger time, is essential to the quality control of loads such as components at Singer-Bridgeport. Today high reliability in engineering, precision assembly and cleanroom conditions and assembly make Singer-Bridgeport a prime supplier to the military and subcontractors. Test facilities provide the range of environments needed to check out components and systems to close specification: acceleration, vibration and shock, temperature, altitude, humidity, air density, conditions. Military and industrial procurement rules find both quickly control and quality production at Singer-Bridgeport.

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HOW FMC's CHEMICAL AND MECHANICAL EXPERIENCE SOLVES MISSILE PROPELLANT PROBLEMS

Food Machinery and Chemical Corporation, through its integrated divisional operation, offers a unique capability for the design and production of missile propellant handling equipment.

FMC's chemical background covers years of research, development and production of toxic fuels, including high-strength hydrogen peroxide and Dimerite® (UDMH). Utilizing this extensive experience, FMC's Ordnance Division has developed many new processes, systems, and equipment for use in solving critical problems in the handling of missile propellants, among them high-accuracy metering equipment, and the Nomac decontamination system.

For more detailed information on these studies and for experienced counsel on missile fueling problems, contact FMC, a leading developer and producer of chemical propellant compounds and the equipment to handle them.

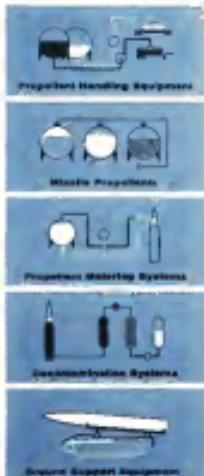
For further information, write on company letterhead to Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, Calif. Phone CYPrus 4-6126.

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fmc

Illustrated below are some of the activities of FMC concerned with missile propellants and propellant handling equipment, which help define a few of the problems successfully solved by utilizing the combination of chemical and mechanical engineering talent available.



FMC's New Liquid Propellant Metering System Achieves Accuracy to $\pm 0.1\%$



Mobile metering and control unit for fueling liquid propellant missiles.

The overall reliability of missileage missiles is influenced by the accurate measurement and delivery of liquid propellant to the missile tanks. For example, a small error in fuel weight could adversely affect the in-flight performance of the missile, causing possible failure of the entire mission.

Ford Machinery and Chemical Corporation's Ordnance Division has recently developed a mobile liquid propellant metering and handling system which promises to solve many missile fueling problems. The advantages offered by this unique new system are many:

Accurately measures and records the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of $\pm 0.3\%$. Extreme tests, exercised by government test equipment, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to $\pm 0.1\%$.

Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sensed and the flow corrected for variations in temperature and density. In addition, the fuel which separates in the missile tanks is removed in the system, condensed, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such stable liquid propellants as hydrazine, nitrogen tetroxide (UDMH) and nitric acid.

Designed to manufacture and safe to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design minimizes human errors and dangers to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a mobile station for the monitoring of fueling operations.

The successful development of this mobile metering and handling system by the engineering staff of FMC's Ordnance Division is another achievement made possible by utilizing the unique combination of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.

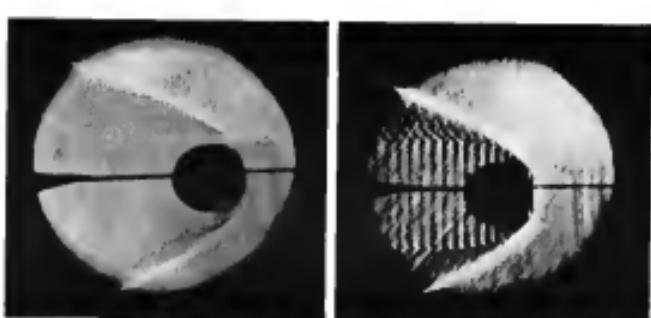
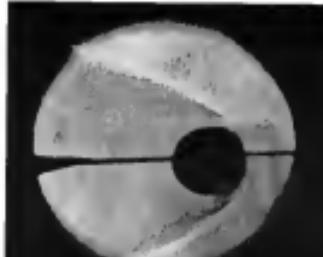
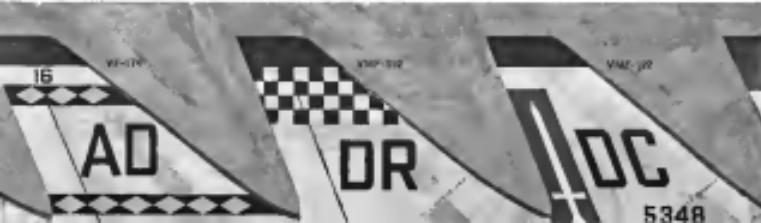


THE ABC'S OF CRUSADER POWER
Fighter for fighter, the Navy's Crusader has logged more flight time than any other 1,000-plus-mph aircraft in U.S. service. Since 1958, this fighter-bomber has flown the Free World's border-watch from Lebanon to Formosa. Over 700 carrier- and land-based Crusaders have earned the markings of Navy and Marine Corps squadrons.* This year they are being joined by a new Crusader — the all-weather F4U-2N. A missile-arming, radar-picketed extension of the basic Crusader design, the -2N takes over the Peewee Patrol at nearly twice the speed of sound!

**CHANCE
VOUGHT**  **AERONAUTICS
DIVISION** DALLAS, TEXAS



*These markings are representative of the 10 Navy and Marine squadrons being discussed.



SHOCKS At Mach 1.5 (left) shows laminar combustion wave (bright) and wind shock (dark) wave reflected in front surface. Schlieren photo was taken in National Bureau of Standards experimental program. Interfered combustion starting at the front of shock at right moving through hydrogen mixture at Mach 4.00 shows the high frequency of the oscillations in clear, shaded bands.

Supersonic Combustion Probed

New techniques for studying supersonic combustion by photographing the flight of small frequency waves through combustible gases have been developed at the National Bureau of Standards.

Early results from the experimental aircraft-mounted schlieren pictures of laminar combustion at a supersonic gas mixture, taken for the first time this year, have been published.

Application of the methods will provide insight into the problems of supersonic flight when waves on vehicles in order to reduce the drag or increase the thrust by external heating. Data for the design of future fighters for supersonic combustion could also be one dividend of the program.

Supersonic Combustion

Supersonic combustion has been studied in the past by using shock wave, dissociating, and fire tubes.

The Bureau's work on these results has been indigenous and that the shock wave experiments can be compared to the conditions of a moving gas stream and a stationary wave on a fixed object.

The Bureau's approach, chosen by J. W. Ringer of the combustion controls group, is to establish the shock wave ahead of the moving nozzle and then to reduce combustion. Stagnation temperatures are constant and results are not affected by moving methods or techniques.

Velocity up to 2.75 times diameter are held prior to a mixture of hydrogen and air at Mach numbers between 0.2

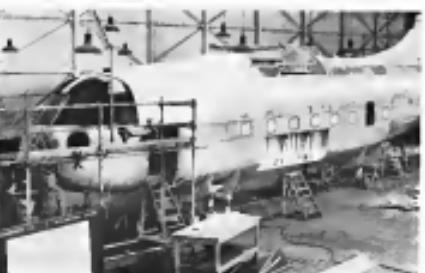
and 6.5. Combustion was caused by compression and heating in the shock wave standing in the nozzle.

One set of tests showed that combustion was steady around Mach 4 with separate shock and laminar combustion waves established in the leading surface of the nozzle. But at above Mach 5 combustion became intermittent and at

higher speeds the wave appeared to be a strong detonation wave which originated in a shock and a laminar combustion wave.

At pressures of 3 and 4 atmospheres, stagnation temperature in the detonation wave increased to 1,000°C and 1,300°C respectively due to the nozzle speed.

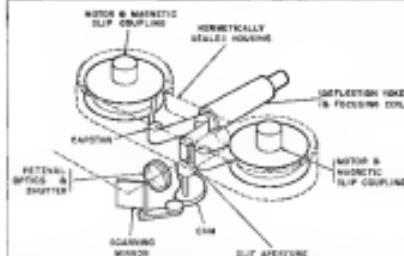
Frequency of the intermittent combustion was estimated at 800 cps.



Breguet 941 STOL Prototype Takes Shape

First flight of Breguet 941 French STOL single aircraft, in end of 1971 for certification work on completion of first flight next April. Type 941 uses vectored-thrust engines, propellers to reduce climb angle, and ailerons. During the development from low-bypass propellers shown in this Wiesemann Tauran 8E-D technology engine. Changes to complete flying mockup of Type 942 a pressurized passenger-carrying prototype, to prospective cabin dimensions. Type 942 would carry 18 passengers, in an arrangement of 40 passengers and 600 cu ft of cargo, in a fuselage with cabin cross-section of 4.93 ft diameter.

AVIONICS



ELECTROSTATIC TAPE camera (left) which records images on plastic tape by means of electrostatic charge, overcomes many of the advantages of magnetic tape and photographic film without certain of their disadvantages for space applications. New system developed by Radio Corporation of America, will be used on Nimbus meteorological satellite. Recording coverage of each surface which can be transmitted via tape has about a 100-microsecond latency in storage as a function of desired resolution and available satellite transmitter power budget, with as many as 1000 images per day. Radio Corporation of America's Astro-Electronics Division, larger number of ground stations, permitting longer period of transmission, reduces satellite bandwidth for given coverage.

Nimbus Will Test Electrostatic Camera

By Philip J. Klass

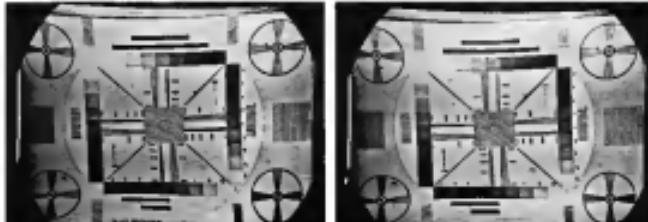
Princeton, N. J.—New type of recorder for satellite use, which records images electrostatically on plastic tape, is being developed here for the National Aeronautics and Space Administration's advanced meteorological satellite, Nimbus, by Radio Corporation of America's Astro-Electronics Division.

The new "electrostatic tape camera" provides an image recording technique which combines many of the advantages of magnetic tape and photographic film without the disadvantages of these media for space applications.

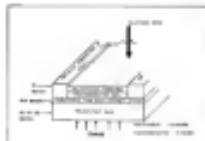
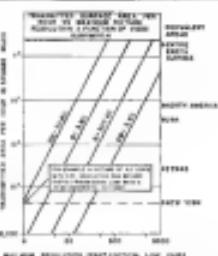
For example, the new camera's plastic

film has a data storage capacity which is considerably greater than that of magnetic tape and is comparable to that of photographic film. But like magnetic tape, no on-board thermal processing is required to read out the images. The image can be stored for extended periods, yet can be rapidly erased if desired and the plastic film around

the electrostatically recorded plastic film could be retrieved from orbit in a re-entry capsule without danger of damage by Van Allen or other radio fields to which photographic film is extremely susceptible. The image can be read out electronically and transmitted by radio to the earth.



FIRST READOUT of television test pattern image stored for five days on electrostatic tape, shown left, reveals good detail and 100-line reproduction. Second readout, shown right, immediately following test shows very slight loss of detail.



ELECTROSTATIC TAPE camera of transmitter plane has, compared with tape, gold lines, thin as a photographic and as durable, for which carrier charge passes of image

under surveillance, according to RCA.

Although not required for the NASA Nimbus application, the electrostatic camera holds promise of extremely high resolution, according to Richard Colton, manager of smaller and wider systems for Astro-Electronics Division. This suggests that the new image recording technique could find use in military reconnaissance vehicles.

Weight Air Development Division's Remotescan Laboratory is actively pushing development of image recording techniques which do not use conventional after-burner exhausts which are vulnerable to radiation from Van Allen belts and nuclear explosions (AW Aug. 2, '61).

The factor which limits the resolution of the electrostatic camera is not the grain of the recording medium, as in a conventional photographic film, but rather the intrinsic chargeable character of the electric beam which is used to read out the stored image.

Experimental models of the new type camera have been constructed to test the principle, and a fully operational model is expected to be available within one year.

A simplified version, suitable for amateur television use, with resolution equivalent to that obtainable with photographic film, could be built in the summer of 1962, if RCA got the go-ahead today, according to Robert Krause, vice president and general manager of Astro-Electronics.

How It Operates

Although RCA's electrostatic camera and General Electric's new thermoplastic recording technique (AW Jan. 16, p. 87) both use plastic tape as the recording medium, the two techniques are fundamentally different.

RCA's thermoplastic recording uses plastic tape coated with nonconductive, conductive film on top of which is a hard-coated layer of a thermoplastic film. Information is stored on the three-layer film by means of an electron gun which produces a writing pattern of charge. The film then is subjected



COMPARATIVE DETAIL that can be obtained with two different optical resolutions is shown in these photographs of Newark International Airport. Photo above has resolution of 10 ft. per optical pixel while that below is 0.3 ft. per optical pixel. Photographs were made using a simulator developed by Radio Corporation of America which projects optical photons to be viewed with a wide range of resolutions.



This is systems capability at NAA-Columbus

The Columbus Division of North American Aviation is one of the most complete centers of advanced systems technology in the world. Much of the progress in our modern technology was pioneered in the extensive facilities operated by the Columbus Division. Here practical production evolves swiftly from original concepts. Economy through efficiency is the constant theme. This is true systems management capability... this is the Columbus Division.

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NEW TARGET MISSILE. Two missiles in one, this unique target missile can carry out either high or low level missions equally well. It performs from subsonic through Mach 2 speeds, and from ground level to 60,000 feet. Under development for the Army by the Columbus Division, it is rocket launched missile powered.



GROUND LEVEL ESCAPE. The first successful rocket-boosted ground-level escape system was developed by Columbus. In case of emergency it is equally effective on the ground or in the air... at landing or jet speeds.



RESEARCH AND DEVELOPMENT. Oxygen research at Columbus led to the development of liquid oxygen systems for aircraft. Now one cubic foot of LOX can replace 800 cubic feet of gaseous oxygen.



THE 100 "EAS." The world's largest radio telescope reflector, 690 feet in diameter and more than seven acres in area, is being built by the Columbus Division for the U.S. Naval Radio Research Station in Biggs Grove, West Virginia. The 100-foot thick movable reflector will have a potential range of billions of light years.

The stored image can be made immediately or the tape can be reeled up and transferred another time.

To convert the electronic signals into the tape, the electrical signals which can be transmitted back to earth, the tape is caused into motion in front of an electron beam. This one instant is tightly focused for optimum resolution, in contrast to the broad beam used to project the initial charge on the phototube surface.

The resultant beam is caused to scan the surface of the phototube modulator by conventional electromagnetic (or electrostatic) deflection plates. As the electron beam scans the phototube, the current of beam current that flows at that instant will be inversely proportional to the electrostatic charge level of that area and therefore directly proportional to the light intensity of the original image at that point.

The motion of the song, by the finely timed electron beam, results in some loss of charge differential between light and dark areas of the original image.

In a demonstration for Aviation Week an image that was recorded set hours earlier was read out four times before there was significant loss of detail.

To erase the electrostatic charge stored under the entire phototube modulator surface is accomplished in a four-step electron beam which erases the charge across the entire surface.

Performance

The ultimate resolution of the electrostatic tape, measured as equal to that obtainable from conventional TV video cameras, according to RCA scientists.

The quantum efficiency of the semi-conductor photodiode is about 50%, making it comparable to photographic film in sensitivity.

A peak brightness capability of 0.01 foot candles per square foot is expected for photomagnetic standard TV set pictures, according to RCA. With the use of electron image intensifying techniques, now under investigation here the electrostatic tape images could operate at light levels only 1/10,000th as high. A three-stage image intensifier could cut required light level by a factor of perhaps 50,000 to, RCA believes.

The most significant factor in determining the resolution obtainable with the new electrostatic tape camera is the spot size of the resultant electron beam. Considerable effort is under way at RCA in developing techniques for reducing beam spot size. One promising technique is to use a magnifying electron lens.

Computer scientists here are confident that within several years it will be

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CONWAY
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REGULATORY APPROVED - DERRY - ENGLAND AIR ENGINES - HOUSE CAR - DARTS AND GULFSTREAM ENGINES - BOEING MOTORS - RUSSIAN PROPELLOR



Datacom Control-Display Link

Control-Display Link, called Datacom, between a data processor unit and its input-output device, displays input output in alphanumeric form on cathode ray tube for inspection by human operator before transmission to machine or system device. Operator can approve, edit or correct any of the displayed information before transmitting its message to data processing system or control device. Datacom includes magnetic storage device, built into desk panel, with capacity of 3,072 bits for storing information during inspection. Datacom can read and receive data at approximately 1,000 characters per second. Manufactured: The Electrodata Corp., Elginbrook Division, Elgin City, Calif.

possible to produce electrostatic image cameras that can match the looking angle of up to 100° at speed better per inch/cm obtained with conventional photographic film.

Callas points out that the whole question of photographic materials, in terms of being able to discriminate between different objects of interest, is neither well defined nor understood at present. (National Bureau of Standards has recently developed a test camera system, preparing 30,000 lines per inch, to be used in conjunction with the data system for developing a standard method for discriminating the resulting types of photographic materials. Because there is no such standard at present.)

Imaging Simulator

RCA's Astro Electronics Division has concentrated an image simulator which is able to discriminate in the same way as the eye. It is intended to evaluate and examine processing techniques on a human observer's ability to pick out important details from an aerial or surface photograph.

The simulator can produce a TV picture with a resolution ranging from 120 to 1,000 lines. This can be adjusted to correspond to that measured in radio transmission to determine its effect on intelligibility. Control knobs permit the operator to stretch the gray scale of the picture to bring out more detail or to contract areas of equal

brightness (or darkness). There is a per pedestal switch for analyzing pictures taken in the same place of visual form, to locate the most interesting intensity levels. Other controls which define exactly the video signal producing a video display which resembles a television screen can be used to bring out details which might otherwise elude the human observer.

The Astro Electronics Division also is developing a new means for producing photographs of video information received from a television camera or a television station. At present this is done by recording data on magnetic tape, playing it back over a TV type camera, then photographing the monitor with a camera.

RCA believes that pictures can be performed in a single step by using an electron beam modulated by the receiver video signal, to record the picture directly on a photographic plate. (The same principle has been used in electron microscopes.) In this way the distortion which occurs in the camera line and the smearing that occurs in the TV screen phosphor will be eliminated. Here as with the electrostatic image camera the resolution will depend upon the ability to obtain a finely focused electron beam.

The division here is building an experimental model, using for such work what is expected to be most photographic work at sea.

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Somewhere North of Baffin Bay

The Arctic is almost as silent and lifeless as an ice-cube. But, deep inside it, these 400-foot long missile-detection antennas will guard the life of our country.

They're part of a Ballistic Missile Early Warning System (BMEWS). Obviously, you'd call them surveillance radar antennas. Yet, they look like over-sized baseball mitts. That web-like framework can detect (or spot) a far-off missile darting through the silvery Arctic sky, and rifle its speed and direction to any of our military bases in seconds.

Up here, weather is a constant battle. Arctic storms slam into the 185-foot high antennas, and make ice figures back and forth over the mesh-faced structures. But they'll stand for years. The O. S. Kennedy Company, builders, made certain of that by weaving foot after foot of USS National Seamless Mechanical Tub-

ing into every antenna.

USS National Seamless Mechanical Tubing is an ideal load-carrying member, because it resists bending stresses in all directions and gives you a superior cross section. It absorbs and locates shock. And for a given size and weight, the tubular form withstands more load than other sections.

USS National Seamless Mechanical Tubing also fabricates easily into parts. It's stocked by National Tube Distributors all over the country. They will gladly show you how to use USS National Mechanical Tubing in your next application. See your National Tube Distributor.

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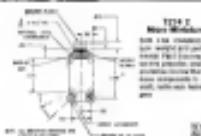
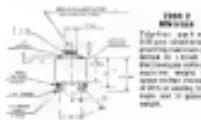
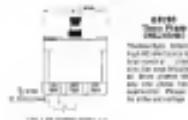
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Data Processing Advances in West Europe

Wiesbaden—Digital computer technology in Europe is in its infancy, but large U.S. military funding for defense purposes in several years ahead of data processing in Western Europe. But West European scientists are doing excellent work in computers theory and concepts, and their industry is赶上ing as it has in the U.S.

This is the opinion of Hans L. Auerbach, top computer specialist who has just completed a one-month tour of West European computer industry in Bonn and Frankfurt under the sponsorship of the Office of Naval Research, Auerbach, who heads a computer detection engineering firm bearing his name, did not visit Russia during this trip.

Progress Report

Auerbach and Britain agreed to the U.S. at present in the state of its computer technology, but experts here say it will be another two or three years German and Japan are also moving up fast in computer technology.

Auerbach cites reports that the Red Chinese continue to extend the R&D work with these space development of computer technology. Our visit often

Red Chinese scientists visit Russia for a look at the Soviet Union's digital computers, where they had conducted a comprehensive survey, Auerbach says.

The area of data processing promises to rapidly expand to every nation. Auerbach says, "There is no doubt that the quantity of a country's information processing system is as valid an index of its economic progress as, for example, kilowatt hours of electric power or tons of steel it produces."

Auerbach is partial to research and development in Britain, which was more West European countries, as in the U.S. Auerbach points. Among the most interesting programs cited by Auerbach were the following:

• **Alphanumeric character recognition**, using novel technique which ignores imperfections in the character or deviations from the standard character shape, under investigation at Technische Hochschule Karlsruhe, Germany. Total of 19 measurements made in the character to avoid around 1000 possible characters are sufficient to identify the character. Technique is based on principle of measuring character shape by the potential gradient its shape produces.

• **Technische Hochschule Vienna** is experimenting with magnetic cores to strengthen magnetic fields of conditioned refrigerators.

• **Solitron Electronic Corp.**, Ltd., Britain, has developed a clever capsule of reading fixed tape four characters at a rate of 240 per second, and rate can be increased up to 3,000 per second. Auerbach was told.

Storage-Memory

The University of Manchester, Britain, has developed a new type of local high-speed memory for storage of small amounts of data and information. It is similar in operation to ferrite core memory, except that it uses solid rods which eliminate the costly and difficult task of threading wire cores. The memory consists of a large piece of metal mesh, resembling a window screen, with ferrite rods and thin wires also placed in the holes between the wires. One unit about Auerbach says, stores 3,092 characters, approximately 1000 words, 4 1/2 ft. deep, 3.9 ft. wide, 3.9 ft. high, and cycle time of less than 0.2 microseconds and cycle time of less than 0.4 microseconds. Memory will be used in University of Manchester's MUSE computer and the

West European Computers

More complete manufacturers and laboratories in West Europe and the names/locations of computers they produce or are now developing, cited by Hans L. Auerbach, include the following:

► GREAT BRITAIN

- IBM Computers, Ltd. LEED 1, II and III
- Ferranti Ltd. Mark I, Perseus I, II, Murray, Precess-Aqua, Series A/B, Orton and Apollo
- Elliott Bros. 902, 912, 915, 916 and 918
- EDSAC, Manchester, Ltd. UNIVAC 1000, 2000
- International Computer and Tabulating, Ltd. 1202, 1300
- Standard Telephone & Cables STANAG 2000, 3000, 4000
- University of Manchester, Manchester, England

► FRANCE

- Compagnie des Machines Bull, Grenoble 3, Grenoble 60 and 730 DF
- Societe D'Electronique et D'Automatique (SEA), C.A.B. 900, C.A.B. 1010, SEA 3000 SEA 3000
- Societe Nouvelle D'Electronique (SNE), C.I. 901

► WEST GERMANY

- Siemens & Halske 2000
- Telefunken TR-4, TR-5
- Olivetti Werke, Göttingen
- Institut für Elektronik, Erlangen

► ZURICH, ZUG, KANTON

- Skr. Planck Institut für Physik, Munich, G-7
- Technische Hochschule München, FERM
- Technische Hochschule Darmstadt, DGERA

► ITALY

- Olivetti, ELEA 5001, ELEA 6001
- University of Pisa, CEP

► SWITZERLAND

- Swiss Federal Institute of Technology, ERNESTHE

► THE NETHERLANDS

- N. V. Electrotechniek X1
- N. V. Philips, Eindhoven, Sheld, Mees, Lins, Meijer
- Mathematisch Centrum, Amsterdam, Fries

► SWEDEN

- Fören. ESK, ESKB-2
- ASEA, Borlänge
- ASEA, Bofors, Nyköping (A.B.N.J. Wigstrand 1000)
- Stockholm School of Computing Machinery, Royal Institute of Technology, Stockholm

► DENMARK

- Copenhagen Data, Copenhagen

► AUSTRIA

- Technische Hochschule Wien, Maschinen (English branch), MMG spring factory, a spinning company on the machine's speed and capacity equipped with the U.S. "Whiz-wolf" computer, originally developed for oil田勘探 problems.)



1. When searchers detect an enemy submarine, a homing missile automatically leaves the launcher, reaches high speed, and descends on the submarine's location. Upon command, a rocket-propelled ballistic missile is fired.



2. The missile follows a ballistic trajectory, overshooting its target, misses and returns before water runs out. When the payload is a torpedo, a parachute descends in flight to allow the missile's payload to return near the target.



3. After hitting the target, the ASROC missile becomes inert and floats to the surface of the water. The wake of the missile becomes an excellent hunting search tool which is highly visible on bright and patches of the ocean.

Swift and precise sequential control of Honeywell's ASROC provides the first long-range anti-submarine weapon

From initial target detection through firing and ultimate target contact, ASROC's automatic system delivers an unusually destructive missile from thousands of yards away—all in a matter of seconds!

Development of ASROC started with an idea and over 100 of thousands of hours of intensive operation. Honeywell gave Honeywell the assignment, the responsibility of designing, developing, testing and producing the entire system under contract direction of the Naval Ordnance Test Station.

The ASROC concept was based on proven technology at the time the program was started, but is enhanced for exhaustive test programs, carried out by the Navy-Marine well team, to develop ASROC from idea to hardware.

Early in the program, prototype missiles were set free morally and from existing platforms in the Naval Ordnance Test Station to obtain aerodynamic research information. Engineers measured, recorded and compared data and distances for short duration, uniform separation and payload impact.

Hydrodynamic information was obtained from dropping probe free-fall into the water from a height equal to dropped probe depth into a hydrophone range. Calculations on trajectory, hydrodynamic stability and depth rate rates contributed to design. Throughout the development program, more than 100 test flights were conducted.

The result is an integrated weapon system consisting of an underwater search detection device, an exocet homing head, a control computer, a missile launcher, the ASROC missile and all necessary training equipment.

The function of ASROC depends on an available for development of key examples control problems of missile to aircraft systems and components. If you have a problem in the design of systems or components, call or write Honeywell Systems Products Group, Honeywell International, 1000 Canada Way, Honeywell Control, Limited, Woodcliff Avenue, Lachine, Quebec H3Z 2T, Canada.

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The Task — Provide *ordered* outcome for *multiple* *multiple* *dimensions*
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In *Palmaria subcrenata* and other maritime aglyphonans, these *frictionless* bearings, developed by *Nostromus*, are particularly suited to relatively *frictionless* support of a large structure, which can be positioned accurately by a servo system with no *mechanisms*, *measured* or *loading* — just *extremely stiff* under applied loads.

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Central Asia Review

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NORTHROP CORPORATION



Boeing Antenna Design Models

Microtus mohicanus for sale in Ontario, stated down from a 200 ft. diameter, a checked by following measurements. At left is model of an R-10 satellite transponder used for scientific tracking. At center is another model of an R-10 satellite tracking, and at upper center is a cross section of a rocket motor survival capsule.

Min being built by Ternion, Ltd. The A10 will have a storage capacity of one million words, half of it programmed by the factory and matrix, the other half by magnetic drum. Operating feature of the machine will be its ability to "learn" which elements in the total matrix are not being used and changing its position of the problem and matrix to automatically transfer that selection to a magnetic drum to make room for it, matrix for other more frequently used commands.

Wind Gear Storage

Aerobach found considerably more interest in and use of wood core and translucent memory storage in West Europe than in the U. S. In The Netherlands, N. V. Elektronica has developed a novel machine for unidirectional sorting of tree fruit crops. Mabuyi operates under control of a punched tape program.

Modern-cost, large capacity, saw arm auto tape unit is being developed by Standard Elektrik Lucas of West Germany, for handling air passenger reservations of British European Airways and Air France. The system, called the K 10, employs 10 tape transfer heads in which magnetic type is stored. The K 10 has state reservation input to an older Bembridge electronic cash register with 175 ft. of tape, which capable of storing three million



TRIWELL® ELECTRONIC CHASSIS LATCH
A handsome, strong and durable handle designed to
secure "plugs in" fast electronic chassis. Provides
the positive security and reliability of the chassis
latch assembly. An eight to one mechanical advantage
with a unique one-half inch take up.



PRECISE DC TO DC AMPLIFIER

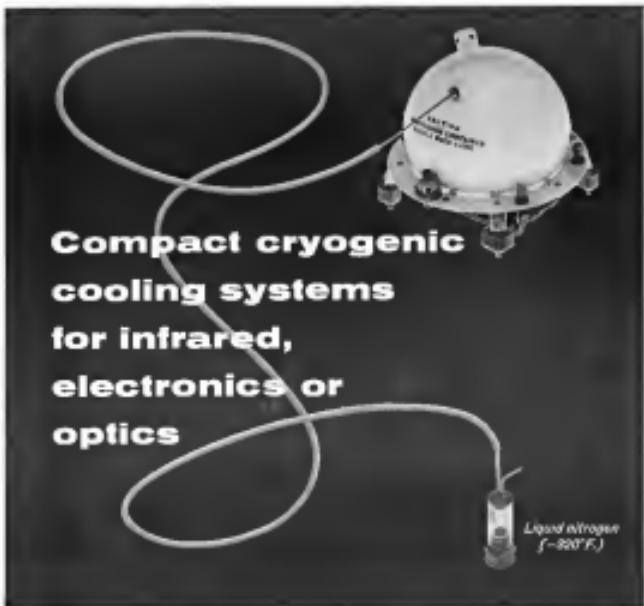


The new amplifier assembly consists of an input reverberation modulator, a high gain AC amplifier and an electrical demodulator output. With associated Ratiometer network associated Dc/Dc as 04810, this assembly functions as a DC open-circuited amplifier with a gain in the range of 8 to 10 - with an accuracy of $\pm 0.02\%$. The amplifier is also capable of delivering 10 volts DC to any load in excess of 5000 ohms.

2020-2021 学年高二物理上册



GENERAL PRECISIONS, INC.



Compact cryogenic cooling systems for infrared, electronics or optics

New AiResearch system delivers nitrogen in liquid form from storage system to cooling area

New units requiring refrigeration cooling are being used in designs with accuracies made for bolley registers or point image tasks.

The AiResearch system transfers the coolant in liquid form to a point of use 25 feet or more away. The liquid is pumped through an unobtrusive, small, flexible tube which can be bent over and around obstacles. Because the storage system can be placed anywhere space limitations are overcome and intricate installation problems are simplified.



AIResearch Manufacturing Divisions

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decimal digits, with an average access time of 10 sec. The device can read out or write in continuously in four bytes. The unit will sell for less than \$15,000. An order was bid.

This Film Memory

In West European laboratories, as in the U.S., there is considerable effort in thin-film storage. International Business Machines Corp.'s laboratory in Zurich has done basic research in this field. Their finding that thin films have an intrinsic ferromagnetic resonance, of about 1.000 cps, suggests that the first commercial memory system with thin film will be of the order of 0.1 microsecond, which is equivalent to present-day memory IBM Laboratories' studies indicate that the magnetic domain location is important in the control of the advance along the film.

New material for thin films, called Green Alloy, developed by Britain's International Components and Electronics Ltd. (ICT), apparently solves the problem of thin film reproducibility. The film is a thin metal film with a granular surface. Its determined average time of less than one-millionth of a second was told.

However, Aschansk reported, the view that considerably more research is required before thin film memories reach the stage that they can be commercially produced in large areas.

FILTER CENTER

Important new developments in power tubes and semiconductor devices and techniques reported at the recent National Electron Devices Meeting in Washington include the following:

► **High Power Traveling Wave Tube.** A traveling wave tube which produces peak power of more than 40 megawatts and average power of 0.0 kw at 5-GHz, with efficiency as high as 47% and power bandwidths of more than 14%, was described by John Baetz of Varian Associates.

► **High Efficiency Amplifier.** New type of parametric amplifier which uses a helix as a slow wave distributed antenna structure and employs varactor-diode which is diode-biased coupled to the helix was described by C. L. Coates and K. K. N. Goh of Radio Corporation of America. The RCA scientists described a varactor helix parametric amplifier, weighing less than 5 oz., which provides 15 dB of power across a 10% bandwidth at high-stand using a pump frequency that is less than half the input signal frequency. Gains of more than 10 dB have been obtained over narrow bandwidths in the 10-

PROBLEMATICAL RECREATIONS 40



A college president, a professor, an instructor, and a junior are named Mr. Brown, Mr. Green, Mr. White, and Mr. Black, but not respectively. Four students with the same names will be designated here as Brown, Green, White and Black. The student with the same name as professor belongs to Black's fraternity. Mr. Green's daughter lives in Philadelphia. The father of one of the students always confuses White with Green at class, but is an absent-minded. The junior's wife has never seen Mr. Black. Mr. White is the instructor's father-in-law and has no grandchildren. The president's oldest son is never. What are the names of the president, professor, instructor, and junior?

—Contributed by a Recreant

For information on current magnetic recording heads, write to Western Recording Equipment Dept., Western Corporation, 4601 Kossuth Street, Hollywood 38, Calif.

ANSWER TO LAST WEEK'S PUZZLER: Since the intensity of sound diminishes as the square of the distance from the source, the intensity of the sound made by the three roosters makes six feet away must be represented by the number 3/16 and that of the two is at a distance of four feet by the number 2/16. Thus the distance made by the two P.R.'s would be 1/16 times as intense as that of the three M.R.s.

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QUADRATURE REJECTION CIRCUIT

Marshall's quadrature rejection circuit is designed to operate from a 40-cm-pole air-gap magnetized amplifier with a transverse wave multiplier. This small, light and rugged device rejects the component of the input wave which is 90° from the reference signal. The component of the input wave which is in phase with the reference will produce a square wave whose amplitude is proportional to the last magnitude of an electric signal. Marshall's high-performance magnetized circuit is designed to accept an input signal of 8 cps with 100% distortion. At 40 cps the input signal is 2.5 dB. At 400 cps, the capacitor value will be 50.

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special stainless steels
withstand the extremes
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When a missile "lifts off," Corliss special stainless steel is there to withstand the extremes. These plates are the high strength, precipitation-hardening grades, 17-4 PH, 17-7 FHR, and PH 17-7 Mo. And these are just two reasons why these grades are used.

We chose FHR plates for a number of other reasons. The high physical properties and resistance to elevated temperatures make them ideal for space flight engineering. Simplified low temperature heat treatment, with devolatilizing a Rockwell hardness of C60 to C65, tensile strengths up to 180,000 or 220,000 psi in plates.

For applications where high strength at high temperatures and low weight are required, we recommend the precipitation-hardening grade from Corliss. We will be glad to work with you on specific applications.

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been made at frequencies from 60 cps to 100 kc.

► **Wideband Traveling Wave Tube.** A periodically excited traveling wave amplifier design which shows promise of providing bandwidths up to 100 kc at an output from 100 to 800 watts, was described by three Hughes Aircraft scientists R. W. Eng, William Hart and M. V. Kremens. Experimentally tube has achieved 365% bandwidth with sum power output in excess of several kilowatts and 15% gain. With liquid cooling, duty cycles up to 10% are possible using pulsed electron guns or up to 15% with a cathode-pulsed gun, authors reported. The replaceable output waveguide connection, permitting its use as a nuclear applica-

► **High-Speed Analog Digital Converter.** An electron beam tube which can be used to convert analog voltage into eight-bit binary output at sampling rates up to 10 mc, was reported by Dr. M. C. Gandy, Jr., of Sperry Gyroscope Co., Lakewood, Calif. This was a solid electron beam which is electronically deflected by input steering voltage. Beam impinges on a zinc plate containing eight columns of holes, which correspond to binary equivalent of the analog input voltage. Output collector electrodes are for each digit column, produce output currents of 50 microamperes at peak.

► **High Power Marconi Deployer.** An S-band deployer which can switch seven increments of incident peak power with low noise and short recovery time at the rate of one RF cycle, was reported by Dr. M. P. Jorin of General Electric Marconi, Lakewood. In its simplest, switching is accomplished by a single electron-beam resonance control of the permanent magnet gun discharge principle. Tests reported that new deployer has been operated for over 1,500 hr without signs of degraded performance, considerably longer than lifetime of conventional deployer. Unit can be built for frequencies between UHF and X band, with bandwidths of 15%, which is double over 10% of band.

► **Increased Motor Gear-Reducer.** Experiments that柔軟な歴史的背景をもつて、技術的知識と経験を持つ、半導体モーターが、より効率的で、より強力なモーターとなるための、ギヤードモーターの改良を試みた。これらの結果は、G. G. Garrison, Inc.の報告によると、モーターの出力と回転数の積を増加するための、ギヤードモーターの改良を試みた。これらの結果は、G. G. Garrison, Inc.の報告によると、モーターの出力と回転数の積を増加するための、ギヤードモーターの改良を試みた。



KEARFOTT engineered
and now produces
the stabilized
phase follow-up system

for **Talos**

Engineers: Kearfott offers challenging
opportunities in advanced component and
system development.



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Little Falls, New Jersey



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Other Divisions: GPL, Lubriscopic, LMT

LONG RANGE INPUT/1794

News of the coup d'etat from the Alouites was sent to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's optoelectric telegraph system, or relay aerial telegraph, Sept. 1, 1794. A new R&D in relay communications has begun / Today, instantaneous and completely reliable electronic communications insure the immediate and continuous exchange of intelligence throughout the Free World. IERC is proud of its influence and responsibilities in the design, development and manufacture of high precision electronic equipment for the critical applications required in various aerospace and surface roles vital to our National Defense and to satellite achievement. An example is ALR—Avalanche Long Range Input—a program where IERC communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning systems to SAGE—our command and control defense network.



single末级 operation, showed gain-bandwidths of 250, 450 and 1,800 rad for amplifier gains of 20, 30 and 40 dB, respectively, when two active coupled oscillators were used in a cascode circuit. Goodwin reported "With a gain of 40 dB, the maximum gain-bandwidth of 150 rad/sec can be increased to 190 rad/sec using two oscillators. With four oscillators, the product extends the unity gain width and typical transconductance values characteristics were observed. Using six oscillators and a structure period of 280 rad/sec centered at 9,200 rad/sec, a gain of 20 dB and an upper bandwidth of 25 rad/sec were obtained. Rely was cooled to both temperatures of 4.2K for tests.

NEW AVIONIC PRODUCTS

■ Tape-programmed logic analyzer, Model 730, checks cable harnesses for continuity, leakage from wire under test to all other wires, and short circuits. Analyzer provides automatic printout to indicate short circuit and leakage identification to all points. Control wire identification and touch mount identi-



fications. Analyzer in basic configuration can handle 600 wires (1,200 points), or can be expanded to 9,000 wire capacity. Manufactured by California Technical Industries, 1421 Old County Road, Belmont, Calif.

■ Ultralight micro/tach generator, designed to withstand 9,000g lateral shock, and 300g正面 shock, is available



AVIATION WEEK, November 14, 1968

IERC TRANSISTOR HEAT DISSIPATOR



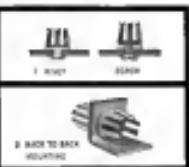
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accepts .305 to .335 variations in TO-5 cases!



IERC Transistor Heat dissipator. Relatively small accommodates diameter variations from .305" to .335" from TO-5 to TO-301 transistor cases. The unique IERC pin contact provides secure contact in specifying, stocking and application.

IERC's unique design features maximum thermal contact with transistor case for efficient transfer of heat to the dissipator and heat sink. Attaching methods suitable for printed circuit boards, chassis and heat sinks provide thermal benefits and reduction in extreme shock and vibration environments. Installation is a simple process. Minimum impact injuries to the transistor.



Buried-lead installation for effective heat dissipation with IERC Transistor Heat Dissipators are illustrated: 1. Pin-to-pin in resist or screw attaching types. 2. Single or multiple mounting on heat sink angle. 3. Back-to-back mounting.

Detailed information, performance graphs, etc. are available in IERC Technical Bulletin. Write for a copy today!



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• **Fast personnel escape seats** are the first generation seats developed for the space program. Type 900106, category 5 in durability, provides virtually no change in speed over temperature range of -65°F to 165°F, according to manufacturer. Motor is available with gear ratio ratios of 6.1 to 46.65:1. Motor can handle up to 180 lb in a peak load. Manufacturer: John Oster Mfg. Co., Atlanta Div., Atlanta, Ga.

• **Telesat lighting relay**, Series 123, reportedly can withstand vibration of 10g to 2,000 cps and shock of 30g while operating at 100% load. When mounted with no contact spacing, the hermetically sealed relay, measuring 11 in. in diameter by 14 in. long, has contact rating of 10 amp for either 115 vac. or 24 vac. for 10,000 operations, or 10 amp for 14-volt operation. Leads are designed for printed board mounting. Operate time is 5 milliseconds and no

time-out is 7 sec. Relay meets MIL-R-557C and MIL-R-1938A, according to manufacturer. Wheelock Signals, Inc., Long Branch, N.J.

• **Broadband video detector**, Type 514-44, for high temperature applications over one over the 40,000 to 75,000

• **Conform multiconductor cable** only 12 mils thick, and accompanying connector designs for use as interconnecting cables, to relay joint connection and in movable bulk and panel device connection. The flexible cable is available in different lengths. Its temperature range is -65 to 210°C. Up to 24 conductors per cable can be assembled in a single cable for maximum performance applications. Hargrave Aircraft Co., Industrial Systems Division, International Airport Station, P.O. Box 99904, Los Angeles 45, Calif.

• **Thermal potentiometer**, Model 580, can withstand environmental extremes set by MIL-R-27309, operate at temperatures up to 200°C and is protected against humidity and corrosion by sealing and pot. Pot is rated at one watt and has 5 in. Telon covered wire leads. Resistance range is 10 ohms to 50 kilohms. Manufacturer: Hanley, Inc., 12660 Paseo St., Los Angeles 45, Calif.

• **High temperature microwave absorber**, previously discussed type CMA-771, can operate up to 800°C with no detectable change in electrical or physical characteristics. Dielectric constant is 9.0 at frequency of 20 cps. Material provides more than 38 dB loss attenuation at 8,000 mc., or 20 dB loss at 14,000 mc., has a density of 4.45, can be machined or molded. Monelmetal Components Co., Caldwell, N.J.

• **Isolation diodes** for use with tunnel diodes in logic and other computer applications, are low level rectifier and detector circuits. Leakage current at 400 millivolts and forward voltage is at 115% of saturation tunnel diode's peak current. Forward voltage drop is guaranteed not to exceed 3.0 millivolts, typical sheet resistance is 3 picofhos. Application



First Nuclear-Powered Radar Installation

Nation's first nuclear-powered radar installation, to be completed for the Defense Department by 1965 at High Wings Peak near Sandstone, Wyo., will generate 1,000 kw. of electric power and supply power for heating facilities. The Marsh Co. is responsible for design and construction of nuclear powerplant. Key elements in the installation include (1) two uranium core chambers, 30 ft high, dry, submersible, (2) heat transfer system for passing steam from water circulating through core, (3) maintenance building, (4) turbine generator, (5) turbine compressor, and (6) radar operations building. Facility is scheduled to become operational by May 1962.



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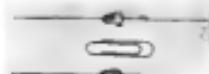


The frequency range, has maximum selectivity of -27 db over entire frequency range for receiver bandwidths of 3.5 mc and 100 kc low frequency roll-off. No external holder is required, with connections provided for several types of headphones. Manufacturer: Minnesota Acoustics, Inc., South Ave., Burlington, Mass.



• **Strain gauge, Model 921, also available with compensating bridge control readout.** Model BCR1-D. The unbalance strain gauge has strain gauge of ± 0.005 in./in. gauge length of 1.35 in., a sensitivity of 1.07 m.v./in. and a measure of 1.47 ± 0.07 in. Gauge provides infinite resolution with non-linear and non-linear hysteresis error of less than ± 0.05 of full scale. Station Instruments, Inc., 15481 W. Olympic Blvd., Los Angeles 61, Calif.

• **Minimous feed-through capacitor, offering high thermal shock resistance, rated at 250 vdc over temperature range of -150° to 175°C.** It is available in electro-tinned brass case in three capacities:



tance values 820, 1,000 and 1,200 mfd. Application data is available from manufacturer: King Electronics, Inc., 915 Mendon Ave., South Pasadena, Calif.

• **High temperature voltage reference, Series 200.** Operates from unregulated 28.5 vdc, provides output of 5.5 to 5.5 vdc, with a deviation of 0.005% for a 10% line voltage change. Temperature coefficient is quoted at 0.001° per degree centigrade from -190° to 190°C. Device can provide non-inverting output current. Voltage reference is packaged in miniature metal case, measuring 1.5 x 1.5 x 1.1 in. for transportation in vacuum-sealed plastic. All semiconductor elements are of silicon. Manufacturer: Viking Industries, Inc., 21415 Roscoe Blvd., Canoga Park, Calif.



• **Ministat crystal filter, with volume of less than one-half cubic inch, has a center frequency of 10 mc, with 2 kc bandwidth at 5 db down and 20 kc at 40 db down, with a load of 5 db.** Device is available with center frequencies of 10 kc to 85 mc. Manufacturer: Electron Laboratories Corp., 4218 Sprague St., Tennessee, Calif.

• **Capacitorous manual switch with peak current ratings of 250, 350, or 1000 and peak-to-ratio ratios of 8:1 are now available for operation over temperature range of -190° to 190°C.** Capacitor is an precision per unit component. Manufacturer: Tandy Electronics Corp., 108 Ahura St., Waltham, Mass.



• **Digital light timer, Type TDC.** For measuring in digital circuit operation or for time delay or timing applications. It is a general digital counter with logical symbols identifying input-output connections and their functions. EG&G, Incorporated Division, 275 Main Ave., Cambridge 39, Mass.

AVIATION WEEK, November 14, 1968

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New Ways To See Fire...



Fenwal

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Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to visually monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to see the hidden areas. Or, FIDO can be used by maintenance crews to check out blind areas in missiles and rockets. Image resolution is on fire or not demands!

Fenwal's Surveillance Detector sees fire or overheat that may occur in large volumes, eliminating the "blindsight" that may be present when point or line detection is used. It operates photopointedly and is sensitive either to the first flicker of a flame or to heat radiation. It is "blind" to daylight and sees the deepest rays of the sun — at "sight" only the potential danger!

These advanced Fenwal safety devices are the end products of long and continuing research. Their complement Fenwal's established capabilities in melt and continuous detectors, and explosion suppression. A Fenwal engineer will gladly supply details. **FENWAL INCORPORATED, 1111 Pleasant Street, Attleboro, Massachusetts**



Soviet Rocket Chief

Marshal Khrushchev's Moscow has been appointed the new chief of the Soviet Rocket Council, successor Marshal Mihail I. Nedelin, who was killed in a Soviet nuclear crash in the Soviet Union.

Formation from the ground stations information from tracking stations is forwarded into the SEC. The SEC is a four tick type telephone center, lines and cables being processed through computers, and tested according to satellite return and then referred to the appropriate room in the control room to closed circuit TV, projection screens and parchment lines. The directly controllable room then may have the data, which may be made and commands sent to tracking stations. In addition to the controls.

Some operational models of the M-10 and Semyorka vehicles will be fitted with automatic Argon engines, some of the most important decisions that might be made will include changing satellite orbits for more flexible surveillance and grouping of several satellites for either more comprehensive coverage of wide areas or greater detail on a specific object.

At the moment, each director will field three 15-ton dual-axle TV monitors and cameras, communication panels, time displays, including Greenwich

OPERATION OVERHAUL



*Our choice for jet-engine pre-cleaning
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by Dean E. Shirk*

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More Time systems, count-down and delayed, stopwatch for stranding and reporting messages, writing desk for transmission of messages over the TV system, and powerline lines and terminals for transmission and reception of messages.

The TV circuit, a high resolution 800-line system, uses the director's three console monitors to be 16 television boards located in the operation and planning rooms, adjacent to the control room and four telephones located in the message rooms, also adjacent to the control room.

The status boards are essentially light boxes with TV cameras mounted in the boxes and focused upon each status indicator. These boards would be placed on the transmitter panel tops of the columns and packed up on the circuit of the 16 boards, four are assigned to each of the three satellite stations, the remaining four are to be used for such general data as weather, tracking station conditions, etc.

Four telephones-one for each satellite station and one for general communications-are also covered by TV cameras. The machines are probably given a seat belt harness, as the Air Force's Air Materiel Agency of Langley, the Pacific Missile Range Agency at Pt Mugu and the Naval Test Center at Vandenberg AFB, all in California, the tracking stations and the downrange stations, do.

Eight large projection screens, forming a curve from diagonal corners of the control room, face the director-controltee teams. Therefore the station and the teams assigned to each team, the two end stations to be used for such general purposes as reviewing the downrange projections, either over a tracking station, satellite television (in this case, ships) vehicles, or carrying up and down for special problems, encountered by say teams which might call for an additional screen to display the conflict.

The state rooms will utilize the projected orbital paths (represented by the satellite and will be compared with the actual paths of the vehicles) on a large plot as displayed on the projection screen. The stations are, although similar to conventional communications models, use separate, multiple images of up to twelve colors on a single screen with a high degree of resolution.

The dynamic projectors are operated from tracking data received in the SDC from the ground stations. The data is first processed through a Control Data Corp. 1604 computer, computational and the results read out on a plotter plot. The tape is then fed into a separate plot generator which translates the input binary code into the scaling voltages necessary to drive the projectors.

In operation, the data bus and data switches would probably send the bus to the switch and base plot the switch, in turn to the dynamic projector, which would compare with the projected orbital paths. If a discrepancy was detected, a rated direct current power source would issue corrective commands to the tracking stations. Subsequently, the team would be clearing the latitudes on the status boards, etc. the closed circuit TV loop on tracking station readiness and conditions (requiring failure would have to be spotted immediately, because of the short time intervals between passes of the satellite, errors from tracking stations, etc. for our capsule recovery), weather, predicted branching and other status information.

USAF Tests Space Food Warmer

Manhattan, N. Y.—Solar thermal radiation will contribute the sole heat source for a space vehicle food warmer now under development by the Wright Air Development Division.

The solar space oven is the result of a WADD contract let to RFF Industries, Menlo Park, Calif., aircraft galleys manufacturer, to develop an efficient food warming device that is independent of electrical power. Prior to this contract, the company developed an electronic oven used in Trojan Heaters (AVW May 9, p. 95).

RFF selected the solar-based oven design after first investigating and discarding the parabolic dish and the individual parabolic heat exchange methods. However, piping and shielding weight in the nuclear method and flames and unavailability of thermal machines precluded the use of these heating techniques.

The capacity of the space oven, in those terms of meal-sized food containers, the Air Force says, that heating is necessary both to make the food more palatable and to reduce the incidence of bacterial hazards.

The thermal radiation collector surface on the 14-in. oven is a 2.8 sq. ft. magnesium plate. The magnesium is cast in two 14-in. pieces for maximum thermal efficiency, with the flanged collector surface on one side connected to the oven heating surface. The other side of the oven is a hinged insulation door.

This is designed to fit snug against the heating surface, thus conducting the thermal energy to all sides of the food to be heated. The insulation door is designed to insulate in a spatial orbit in the vicinity of the earth. The solar flux in the earth's outer atmosphere of about 440 Btu per hr per sq. ft. should bring the food warmer to an equilibrium temperature of about 93°F. On a Men-

hnon dynamics were noted between mission objectives and actual vehicle performance, the director one-table room would require corrective action immediately. Should the director's table require more than 100 watts power, it is possible that the team would have to reschedule the other cycles of that mission to make the power enough for that table's use, until such time as a replacement vehicle could be launched to take its place.

Although this was a research program, continued with the operational status of NASA and Simon, it is assumed that this technology can bring unexpected value to the SDC's program for the space operators, especially specifically, location analysis and the development of various space technologies and ground personnel training purposes.



MAGNEPIE plate of solar space vehicle food warmer holds three times the food in 53 cans.



HEDGEHOPPING AT MACH 1

Lockheed radar shows pilot how to miss what he can't see



When a pilot hogs the desk traveling a mile every four seconds, his route is the world's most dangerous obstacle course. Hills, bridges and other hazards can be in his lap before he has time to maneuver safely over them. He needs information well in advance, particularly in poor visibility or at night.

And now he gets it—from Lockheed Electronics terrain avoidance radar. A compact display shows him obstacles, his position in relation to them, and the maneuvers necessary to avoid them—in time.

Lockheed Electronics systems engineers have created in one group of modules the most versatile airborne radar in flight today. Equally effective as a target-

ing, bombing or navigational radar, this lightweight, transistored unit is typical of the sophisticated equipments developed by Lockheed Electronics to help strengthen the nation's defense.

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COUNTERMEASURES—ECM, ECCM, active and passive
EQUIPMENT: WEAPON CONTROL AND DETECTION—AW, short-range missile detection, fireable and nonfireable
SIMULATION AND TRAINING DEVICES
OPERATORS ANALYSIS—offensive and defensive systems, data systems, electronic warfare, maintenance and space



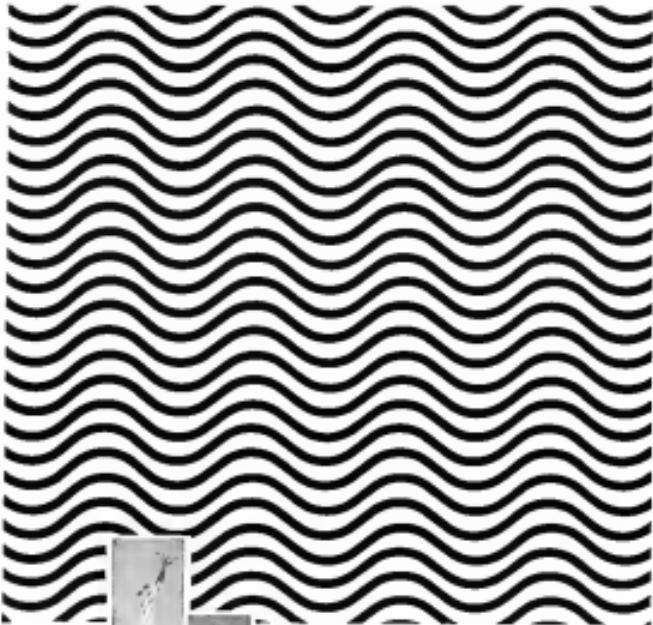
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ammass 0.018 lb/sq per in² sq ft), the equilibrium temperature is 150°F.

Raking time for the spacecraft's food, in an earth orbit, will be approximately 70 days from take-off until a pliable 100°F temperature is obtained. At T-0, temperature prohibiting the use of electrical power to capture the solar energy, the insulation or automatic shutoff devices reflect space to levels to 100°F. In fact, the use of solar energy for heating prevented RJEI from meeting our WAC-10 specification, part of providing an "inert" orbital. The solar oven will operate unless the solar cell is saturated so that the collection rate here is in the dark rate.

One problem in utilizing direct solar energy for heating is that the solar panels must be horizontally mounted. A possible solution to this problem would be to mount them every 120 deg apart about the space vehicle. This, however, would require much of the weight advantage of the solar heat system.

The solar food warmer is equipped with the usual devices to prevent overexposure in non-gravity conditions. Magnetic latches close the oven door and spring clips from the food trays against the door to prevent the door from accidentally opening. The absence of convection currents under serving conditions requires direct contact between the food trays and the magnesium surface.

F-1 Turbopump Test Stand Nearly Complete

Los Angeles—Propulsion test stand for Rocketdyne's 1.5 million lb-thrust L-1 rocket engine is near completion at North American Aviation's South Pasadena Meadville Facility. The stand is a modification of a former propulsive test stand and will be used for checking out turbopumps prior to installation on the F-1 engines for use in launching the Apollo 8.

Completed Phase II, the facility will have three test positions and is to be used for calibration, testing for short term testing and the third for research and development. Normal frequency of testing will be five tests per 16 hr day with a capability of conducting 16 eight hr runs per day.

Loadings available on Phase II are either the 20,000-lb liquid oxygen tank or the 10,000-lb liquid fuel vessel and 12,000-lb water tank.

The engine on the turbopump test test will be operated at a gas generator driven by propellants supplied from tanks other than those containing propellants for the turbopump being tested.

Each of the three test positions on Phase II has a fluorometer to carry off gases generated by the test.

AVIATION WEEK, November 14, 1969



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The stainless steel shell, exclusive with the MIL-C-26500, is extremely light in weight with at least 20% lower specific density of existing surfaces. Its absolute maximum temperature with no coating, is 2,000°F, and maximum operating temperatures.

*Specification, Amendment 1, has been submitted to the National Bureau of Standards (NBS) for approval and adoption.

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Missile Zeus needs none. Tests of the new anti-missile missile show that it will attack enemy ICBMs with 100% accuracy at a distance of 100 miles — Zeus' Zeus predecessor that was on duty around

the approaching ICBM with an explosive curtain.

The newest member of the famous Douglas Nike family, Zeus was developed in a joint Douglas-Electric, Bell Telephone, Douglas Aircraft project. Its design combines the most successful lessons learned from Ajax and Hercules — Nike Zeus predecessor that was on duty around

many important U.S. cities and industrial centers and with NATO forces overseas.

DOUGLAS

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Army Tests Toxicity Of Boron Hydride Fuel

Tests carried out by the Army Chemical Warfare Laboratories show that high-energy boron hydride fuels and their boron oxide exhaust product produce no health effects when applied to the skin and to the eyes of rabbits, rats, dogs and other animals.

The toxicity of these materials varied from one type of animal to the next in rabbits, for example, boron oxide caused convulsions and, applied to their test beds, produced an increase in respiration rate, while sodium boron applied topically for extended periods of time led to significant changes in their urine. Boron hydride appears to be a serious health hazard to life, gases, pigs, rabbits and cats, but it is not expected to be a serious health hazard to man.

Dogs, however, which are taken boron oxide in animal form for periods up to 21 weeks showed no signs of poisoning or paroxysms. The tests also showed that boron hydride can be effectively flushed from the skin of test animals with a solid solution of ammonia, and this flushing agent is considered suitable for humans that may come into contact with the fuel. Testing of boron hydride and boron oxide continues with further protection extending to the report.

Two reports on the tests, PB 161771 and PB 161772, are available at 10 cents each from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Areas Rockets Study High Altitude Weather

Engle AFB, Fla.—Series of 180 rocket flights, planned to study meteorological conditions between 100,000 and 200,000 ft, is being conducted here jointly by the USAF Air Proving Ground Center and Cambridge Research Laboratories, Bedford, Mass.

The Area research rockets, made by Allis-Chalmers Corp., Milwaukee, Wis., are carrying small temperature and pressure sensors developed by G. T. Schubert, Northfield, Minn., called Balloons (Rocket Balloon Instrument) (ANW Oct. 17, p. 67). At the peak of the rocket's trajectory the nose cone is separated and the balloons inflate. The balloons, which carry reliable radio data collectors internally, descend rapidly from peak altitudes at approximately 180 fpm, slowing gradually as it comes closer to the atmosphere's increased pressure.

Ground radar plots the descent during descent to determine wind direction, atmospheric density and temperature.

Great names—that made scientific filtration possible



Pascal's Law: $\frac{P}{A} = \frac{P}{A}$

"Pressure cannot be applied to a contained liquid in a container without it being transmitted throughout the entire volume of the container."

Kleen-Pac ©1968 1940

Although Pascal's Law is more than 300 years old, it is still one of the basic principles that must be taken into consideration in the design of new products for modern industry. And Air-Maze engineers, in their specialized field of developing better methods of filtering liquids and gases, are ever conscious of the importance of Pascal's discoveries.

For 35 years, whatever the filtration requirements—hydraulic pressures or jet aircraft, air compressors or vacuum pumps—Air-Maze has been at work keeping equipment running better and longer by keeping it clean and free from damaging contaminants.

The products shown below are representative of the many designed and developed by Air-Maze engineers to meet special filtration requirements. If your product involves any gas or liquid that moves, Air-Maze can help you.

High pressure liquid filter assembly used in jet engines and missiles.

Open dust filter, either direct pleated type, for complete air analysis or filter, for liquid or gas applications.

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Magellan F70-4000 system is offered in three, four and five channel versions. Prices starting at \$10,000.00. Options include ruggedized and waterproof cases, ruggedized displays, and a choice of three different keyboards. Contact: Jim Paine and Jack Murray, Field Engineers and Research Manager for Applications and

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MANAGEMENT

Furnas Discusses U. S. Space Planning

In a speech to the Eighth Annual Engineering Management Conference in Chicago, IL, Dr Clifford G. Farris, former Assistant Secretary of Defense (Research & Development) outlined the work on U.S. space planning, its significance, and moral and political forces on engineering management in the space age. Because of its interest to industry, Assistant White is enclosing Dr. Farris' full speech.

In the spring of 1951, a seven-man committee of nine scientists and engineers was appointed to advise the Assistant Secretary of Defense for Research and Development on the technical feasibility and desirability of launching an instrument-carrying earth satellite during the so-called Geophysical Year, which was to extend from Jan. 1, 1953, to June 18, 1953. I was a member of that committee.

There can be a particular reason for such an evidence at that time. A released anti-Soviet agent had been presented to the National Security Council indicating that the Soviet Union was working clandestinely on a missile project and that there was a high probability that Russia would release terrorist in the not distant future. It was anticipated that such a tactic legend would be used, probably as part of a larger political program and strategic issue, however the United States should give very serious consideration to a program pointed toward the monitored launching of the best satellite before the Russians could yield a much

This committee met several times and seriously considered all angles from the scientific and congressional points of view. It was felt that such a program on the part of the United States at that time would be a fatal mistake. Five years later would have been a safer time than for proceeding in an isolated fashion. However, in view of the international situation, it was decided the program should go forward as soon as possible. The committee was then asked to submit a report. The decision was unanimous. That, it was international politics which was the decisive factor in what at first glance was an otherwise neutral.

Parenthetically, I should add that I was one of a trio on the committee which raised in a strong minority report questioning the wisdom of the rocket system which the majority recommended for putting up the first satellite. The minority was convinced

course of recent history would have been better for the United States but it almost certainly would have been different.

Very contact in these proposed properties. As everyone knows, the Vaughan was the one that was selected. The evidence proved that the majority of the men were, indeed, without question, in favor of the Vaughan. The Vaughan was chosen. Had the majority group's recommendation been followed, Ansoldi should almost certainly have had a satellite in orbit before the Ringers. It is interesting to speculate on what the cause of halter might have been, but that recommendation was made by the majority group. The last two men on whom would have been the different, perhaps significantly, is the next to say, seriously, that the

"In the scientifically worthwhile aspects of archiving, I prefer that we are now well ahead of the Russians, even though we still take second place in the weight of single charts that can be put into a census pack through our

"In a substantial degree we have confirmed our technological leadership of five years ago. At the present moment, as a nation, we really can match leadership with as well as flexibility in the development of our space program."

The enhances the most sophisticated and expensive experimental program that the urban has ever undertaken. National Aeronautics and Space Agency has a budget of about \$1.5 billion a year, dedicated largely to space research. The agency's budget is about \$1.2 billion.

The research establishment runs an expensive several billion dollars per year (including production and training) on long range ballistic missiles (which are soon discontinued) and space vehicles.

"...with the Office of State
of Research and Development; and the
chief director of research is Captain
Wright's Research Laboratory. He is the
author of a number of books, including
Anson's *Theorem*; the *New His-
tory of the United States*."



all will be lost. However, there are others who believe that to be an overstatement of the case. There is no doubt about the military requirements for accuracy, long-range satellite systems and for communication satellites to run the satellite and send back the data. The requirement there is at high levels but there are no really definitive answers. Whether the ultimate plan, the program is going to be very expensive. Who is going to make the money and when? Estimate about the progress? The considerations will involve much more than technology.

Scientific Enthusiasm

The physicists and other scientists who are enthusiastic about space contend that no expenditure of money or effort is too great if it leads to a better understanding of any physical aspect. The engineers, who because of the intricate and complex gadgets are somewhat involved in all these programs, are readily infected with the same sort of enthusiasm.

On the other hand, some earth science scientists are viewing the trend with considerable alarm, perhaps based on fiscal prudence. Budgets and research expenses contend that an additional \$100 million expenditure in that field (about the cost of a nuclear space exploration) might very well preclude the breakthrough which could lead to the understanding of the cause and the character of cause for racism. The investigation of high energy photon fluxes for more and more apparatus. They are also thinking of more projects. The proposed two-month accelerator at Stanford will call for a total investment of at least \$125 million.

Some astrophysicists are fearing a relatively revolt. They contend that the budgets are coming in for the investigation into the depths of space and that our ignorance of the important facts about the Seven Seas is truly abysmal.

A number of new astronomical research vessels at a few million dollars apiece are called for, immediately. The geologists want to go under water, too. The "Moby-D" project which will involve drilling into and sampling the inner-most layer of the earth's skin, under about 30,000 ft of water, is most intriguing. Undoubtedly the information obtained would be very important and it might be genera for a budget of about \$50 million.

While military necessity and the scientific urge are compelling motives, they are always backed up by an audience about our international posture. One demands a gage, one to take the shape of a sheath, one that looks innocently like the Banana boat. Even so, there is a tendency among some scientists to post-pone the importance of the pos-

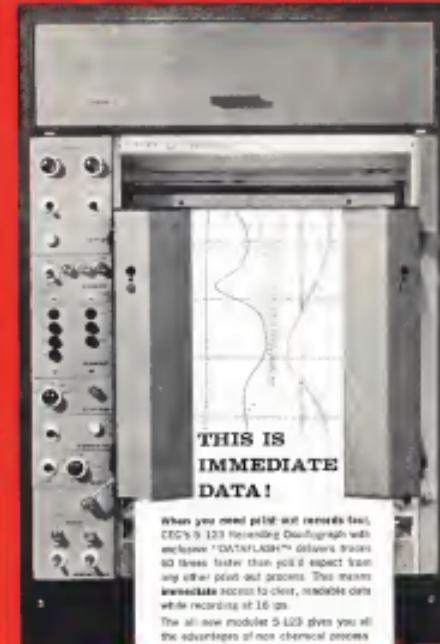
tive factor. They say it is unbecoming of a scientist to have anything to do with, or give any consideration to international geopolitics. However, even they can hardly ignore giving heed to what give evidence of decreasing confidence in America because Russia seems to easily manage similar technological ones. Our national strength is very much at stake and this is a most powerful motivating factor in our national programs.

While the scientists and engineers jockey for position and government support in the glacier fields, the college and university professors stand on the side lines (along with their presidential and wing tips) bawling. "You are abusing us of our health!" they cry. They are not entirely consistent because many of these institutions are heavily involved in extensive research on these important projects. Yet there is no gainsaying the fact that the competition of money, science, project, science and, as some say, patriotism, is destroying the healthy morale of society, as it is manifested at a time when unprecedented demands are being placed on institutions of higher learning.

It is quite evident that there is not enough human talent (and probably not enough financial resources) to do all the wonderful things which America seems to be demanding of itself. Patterns and programs seem to evolve at random or we arrived at by default. It may be contended some great and fine decisions must be made but often we are to be the subjects of an omnivorous dictator, who is to make them? Such decisions in our complex world involve nations which are for the most part beyond the law of legislation, government executive or the usual variety of legal measures.

National Decision-Making

Perhaps they are not aware of it, but the scientists and engineers are playing an increasingly important role in national decision-making. In their parts as employees of government agencies, in the military services, as members of advisory bodies, they frequently are in a prime position for making value judgments about these very complex and important national programs. The creation of the position of Special Assistant to the President for Science and Technology is a dramatic illustration of the unacknowledged results of human evidence of the impact which scientists and technologists have on policy. Argument on non-nuclear fusion. The criteria for making such judgments are not to be found in any textbook, nor are they clearly delineated in any sensible stripdowns of national policy. The role of the scientist and engineer in our national well-being is far more complicated than it ever is in the



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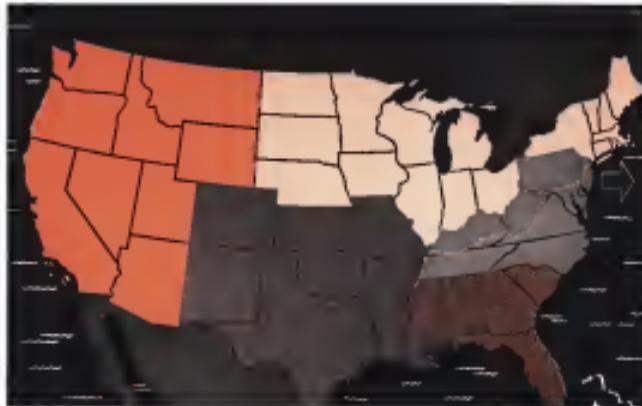
The 4-202 is the smallest temperature compensated instrument you'll find anywhere for measuring accelerations perpendicular to mounting surfaces. It's available now in a range of $\pm 50g$ to $\pm 500g$.

For more information, write for Bulletin CEC 4202-X4.

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Target Missile Sets Altitude Record

RP-15 rocket-powered missile established a new longest missile altitude of 71,900 ft. at White Sands Missile Range, N.M. Manufactured by Keelerian Division, Norbury Corp., the missile attained a speed of Mach 1.03 during flight.

good old days of a generation ago.

Although these major national space loans have, thus far, no names encompassing the whole picture of our technological life, it might be interesting to review some other areas of technology which involved aspects of judgment which we are not inclined to find in the traditional area of scientific innovation.

Bridge Design

One of the outstanding structures in our country is the George Washington Bridge which spans the Hudson River 172nd St. in New York City to the Jersey shore. In the original design the two supporting end columns of the great suspension bridge were to be connected with massive iron rings with molten lead. This would have been the connecting girders of a structure of the kind designed by the architect from the weather. These massive columns were the subject of a great deal of debate and finally, after considerable argument, the design was changed, shortening the distance and leaving the steel towers with their open, lacy structure exposed to the weather, even though the engineers argued against such a change. The decision was made on the assumption that the towers would not reach the ground until then or when they came in contact with a layer of mud or silt.

There was a time when the decision was made on the basis of authority, rather than the real engineering notion that reason.

One of the most debatable and debated projects of the New Deal Days was indulged in the same debate and criticism as the Tennessee Valley project. This program involved the federal support of a wide-spread rural network of electrical systems which individual power companies, either privately or

under the aegis of the Rural Electrification Administration, which began in the same year. The New Deal Days, was indulged in the same debate and criticism as the Tennessee Valley project. This program involved the federal support of a wide-spread rural network of electrical systems which individual power companies, either privately or

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Bottom down the East Coast to Washington, Virginia, an ungodmented meteorological complex. Is a view of most sea transportation and navigation should there be only a few concentrated areas of heavy rain and rainstorms, or should the many scattered areas be spread out in much smaller areas? Thus have been many, if not many, approaches to air planning and some, as far as I know, have been truly competitive in benefit and scope. While, as far as I can picture, the weather radar is not a "silver bullet" solution that adequately solves all problems, if it were properly integrated I am indicating that rather than rain and rainstorms when and if planes from said studies emerge in a point of direction, economic, meteorological and logistic factors will certainly lean as large as technology. However, the decision which must be made will be equally important in the choice of the criteria for the definition of categories in the solution of problems of integrated completeness.

In the years to come a great many American engineers may well be part of this adventure beyond our present boundaries. If our country is to maintain its leadership in Weather radar, a substantial proportion of our technological work has to come from here, and we are here committed to the research and development stage. Our technological progress must surely spread to other areas. I am speaking of more than the present design, layout, use of American business, military operations and foreign aid. One example will suffice to indicate the pattern. Within the next half-century the world population will undoubtedly ex-

plode from the present two and three-quarter billion to five or six billion.

From whence will come all the annual requirements for food, clothing, shelter, energy, minerals and water—the physical requirements for a reasonably acceptable standard of living for these many billions of people? It is obvious that we, as a world, are going to have to learn to get more, and more from less and less in order to meet the basic life demands.

This is going to call for a great deal of basic research knowledge that we have now. The problems of agriculture, irrigation, The expenditures for the necessary research can hardly be handled by individual private industrial organizations for the simple reason that financial profits will be a long time in coming, if ever. Yet if the nations of Western civilization, particularly America, do not worldwide study, develop, the One World Government, we shall—and they will see the year of technological progress to capture the commanding actions of the world.

What research and engineering developments should our nation undertake to help solve the problems of the increasing rapid use of natural resources for itself and the rest of the world? Who should carry them out and how should they be financed? These questions are not just a casual discussion. If they are not, then the world's scientific and technical people will have a major part in determining and influencing the points of application of feasible developments.

In using these examples I have tried to mention which obviously in



Ground Launch of Q-2C Firebee Target Vehicle

From Q-2C Firebee target launching pod with JATO and during ground launch test project successfully completed at Holloman AFB, NM. Target vehicle, previously test flight to be launched in equipped with parachute recovery system.



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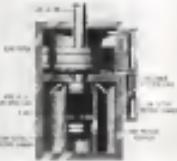


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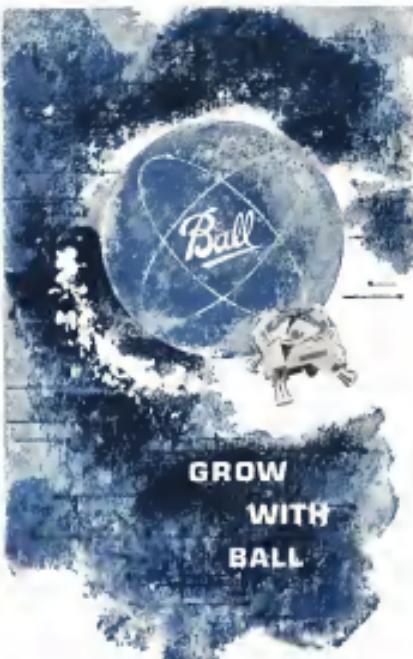


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dynamic, batteries, electronics, insulation, and electro-mechanics and in the design and manufacture of electronic, electrical, and mechanical devices largely for the Department of Defense. Offering 11 275,000 outstanding shares of common stock. These shares are to be offered by United Industrial Corp., a Delaware corporation to the stockholders of AAF Industries on Nov. 16, 1969, for subscription at the rate of one share of Aircraft Armaments stock for each eight shares of United Industrial common stock held, subscription price and underwriting terms to be supplied by underwriter. Purpose of the offering is to provide United Industrial with sufficient funds for general corporate purposes and, together with the distribution of 35,918 shares of the company's common stock to current stockholders of United Industrial as of Sept. 16, 1969, "to spur the market" for the company's stock. United Industrial has an option of returning of 143,000 shares of Aircraft Armaments stock owned by it.

Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Beneficial Holdings for the period July 11 to Aug. 16, 1969, reported the following transactions by three executives of Marquette Corp.: acquisition of 300 capital shares by William Littlewood, director, making a holding of 100; disposition of 250 capital shares by William H. Schubel, director and chairman, making a holding of 514; disposition of 250 capital shares by Harper Woodhead, director, leaving a holding of 5,600.

Other transactions for the period July 11 to Aug. 10 include: Alphatech Airlines, Inc., disposition of 1,000 common shares by John G. Shadley, director, leaving a holding of 1,000; Alphatech Resources Corp., disposition of 210 common shares by W. A. Thompson, director, leaving a holding of 210; disposition of 12,100 common shares by Theodore G. Thompson, director, leaving a holding of 12,100; disposition of 100 common shares by John G. Shadley, director, leaving a holding of 100.

Arrow Corp., disposition of 2,000 common shares by James F. Kelly, director and director of Arrow Electronics, Inc., leaving a holding of 2,000; Arrow Electronics, Inc., disposition of 1,000 common shares by W. A. Thompson, director, leaving a holding of 1,000; disposition of 1,000 common shares by R. K. Wilson, Jr., officer and director, leaving a holding of 1,000.

Bendix Aerospace Corp., disposition of 1,000 common shares by John F. Koenig, director, leaving a holding of 1,000; Bendix Aerospace, Inc., disposition of 1,000 common shares by John F. Koenig, director, leaving a holding of 1,000; disposition of 1,000 common shares by the total holding of 1,000.

Gamma Aircraft Co., disposition of 3,000 common shares by Frank J. Bunting, director.



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CESSNA lightplane (in foreground) and Cherokee high-performance Comanche.



TIPOUCHES of wing can be seen in this view.

Piper has not yet revealed exact specifications for the Cherokee's first two prototypes, however, were built there, although new tooling and jigs are still being installed. Plans will follow a 15-passenger seating at the point stage which will include hydraulic hoists to position the plane for interior painting. Rollout is made directly onto the floor on the way stage.

In looking to the future, Howard Piper said that in his judgment, "We don't believe passenger flight can profitably or safely handle them."

Cherokee Design

The Cherokee will be considered as Piper's new model for 1981, although it's not out this year, two years after the Comanche and what Piper called a "scaled-down" Tri-Pacer. The Cherokee's first flight is planned for the fall of 1980.

Key objective was simply to improve the Tri-Pacer and move into the broad-gauge, low-cost, low-wing field, much as the Cherokee, which started the Comanche. The price, according to Howard Piper, is "very close" to what

the Piper would have been in 1961, if we had continued it."

The Cherokee is of all-metal construction (Piper says fiber is half that expanded on the Comanche) and emphasis was placed on double light structures. The plane will be variable-surface stabilizers and the noseplane. It is still around the experimental tail, but this stability is evident by nose-up pitch and pitch trim wing.

Pipes will cruise in excess of 130 mph. Powerplant is a Lycoming O-320-B 166-hp, four-cylinder, carbureted engine. Standard fuel capacity is 50 gal with additional capacity available to increase capacity to 50 gal. Fuel tank is an integral part of the wing.

The Cherokee has a gross weight of 2,200 lb and an empty weight of 1,115 lb. The gross weight and 1,015 lb.

The Cherokee design objective—the Tri-Pacer's wings and tail but with 1,000-lb plus payload. Fuel consumption will be about 9 gal.

Liber cost are cut because of design simplicity; use of aluminum, which is less expensive than sheet, fabric and tubing, and a cutback in parts, since the Cherokee has 1,280 parts, compared with 1,600 for the Tri-Pacer.

Cherokee has a large baggage compartment with a separate outside door for easy access.

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plus up to the five-day rate using the 100 hp engine, although Howard Piper and the Cherokees will be offered later with a 150-hp powerplant. Models will be Standard, Custom, Super Custom and Aerofine by late 1961.

In the regular line, the 1961 Comanche 260 and Comanche 260 will be improved and optional wing tanks offered without the usual increase in weight. The 1961 Comanche 260 will be offered in 150-hp and 180-hp models. Piper aircraft, director and chief engineer, Tom Self, offers Comanche 260 models up to 1,300 lbs. (full) and by giving up 70 gal. total, up 30 from the present.

The tanks increase the weight 13 lb. but a seat grant has been conditioned for

the 260, raising it from 2,800 lbs. to 2,980 lbs. Another new feature is a fuel dump which can be operated from the interior floor, solving a chronic complaint from owners who are forced to crawl under the low fuselage to dump the tank. Tanks can be drained in flight, if necessary. Turn radius has also been reduced from 25 ft. to 18 ft. passengers also have been made available for the 260.

Improvements to the Apache GA and Apache are relatively minor. The Apache 260 has a new nose door which does look plague for takeoff performance. It looks like the single door handle but can be opened from the outside



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while in the down, as looked, position. On the Apache, the tail rudders have been replaced by Teflon cables for smoother action. Ribs under the fuel cells also have been beefed up. Plans will be offered in blue, tan, green, and red, with white as the complementary color.

In most cases, Piper's 1961 models showed increased power over 1960 models. The 1961 Comanche 260 and 1961 Piper Comanche 260, 150, 180, 205, up 500; Comanche 180, 216, 245, up 545; Super Cub, 175, 200, up 555; and Cherokee, 150, 180, up 545. Actual price has not been announced, please call 549-5000 in 1960.

Production Tooling Started for BA-7

Molino Flygindustri of Malmo, Sweden, is starting tooling for production of the BA-7 light business/sport aircraft built by American West last autumn (AW, June 27, p. 58). Original aircraft designed and built by Eppen Aircraft Company, Inc., of Cincinnati, Ohio, has been disassembled and shipped to Sweden for use in a prototype.

Molino Flygindustri is constructing three basic hull units to be used as demonstrators and for static testing, which will be in U.S. Federal Aviation Agency standards. Douglas buildup Australia has accepted a position as chief of the aircraft division with the Swedish firm and will be responsible for other developments.

First delivery of a production BA-7 will be made to this country late next month to Pioneer Aero Service of Los Angeles, representatives of Molino Flygindustri in this country.

Projected price of the aircraft, twin-engine aircraft, still is above \$35,000.

PRIVATE LINES

Feld Aviation Co., Ltd., has opened its new Aviation Executive Aircraft Center at Malton Airport, Toronto, Ont., Canada. Feld Aviation is headed by Douglas Knott, former Kirby in general manager.

Four Aero Commanders 504A, to be joined in January, have been flown there by Thomas H. Conley, vice president of Aero Sales Co., Ltd., Mississauga, Ontario, pilot, and E. A. Holcombe, Breslau, Ont., navigator. Elapsed time from Oakville, Ont., was 24 hr. 28 min. for average speed of 151 hr. over the 2,186 miles nonstop. Plans were 291 gals. of fuel.

Tennessee Aeromotors Commission has published an Airport Directory of state facilities which includes small

plans and details of every airport. Directory can be obtained without charge from C. E. Morris, airport supervisor, Tennessee Aeromotors Commission, Berry Field, Nashville, Tenn.

Webb Aviation Co., executive and transport aircraft brokers, has opened offices at the Miami Terminal at La Gardo Field, N. W. 14th and Webb, the same as center activities at La Gardo is part of an expansion program.

Rock Helicopters, Inc., San Francisco, has taken delivery of its second Sikorsky 12B helicopter. It will be used for survey and contract work in mountain areas, according to James S. Riddle, president.

Lokheed JetStar has been ordered by F. Eton Co., Ltd., Toronto, Ont., department store organization. Company now operates a Douglas DC-3 and a de Havilland Beaver.

Monte-Carlo amphibious helicopter (AW May 5, 1958, p. 128) now carries magnesium cartridges, carburetors and sheet metal added strength and weight reduction. Company, based at Monte Carlo, and use of magnesium eliminated about 200 lbs. and 4,000 parts. Amphib has top jet rating and costs \$21,000.

Berberich Model 15 twin has been donated to the Smithsonian Institution's National Air Museum, by Red Devil Tools of Union, N. J. Plane is the first Berberich to go on display at the museum. Plane was first built in 1946 for Continental Corp. and was obtained by Red Devil in 1954. Aircraft was turned over to the Smithsonian fully equipped for all weather flying. Previous owner was George L. St., Red Devil board chairman.

Ray Aviation Supply Division, com- (AW Aug. 22, p. 187) flew from Honolulu to San Francisco in 15 hr. 18 min., piloted by Chuck Steele.

General Aeromotors, Inc., of Fort Lake, Mich., is using modified Republic Sea Beast, now designated Tern II, for fishing and hunting charter flights from the Manistique-St. Paul area. Plane is modified by L. B. Smith at Munro, Fla., wings have been modified and new end of center has been installed. In addition, Tern II has a new cockpit and to improve water takeoffs under bad weather conditions. Changes for better fuel economy and Pratt & Whitney R-985-25-BDF engines, from 2,200 to 2,600 shaft horsepower, plus auxiliary power unit. General Aeromotors is headed by Harry J. Nyman, president.

AERO SPACE CAPABILITIES are BROAD at CAE

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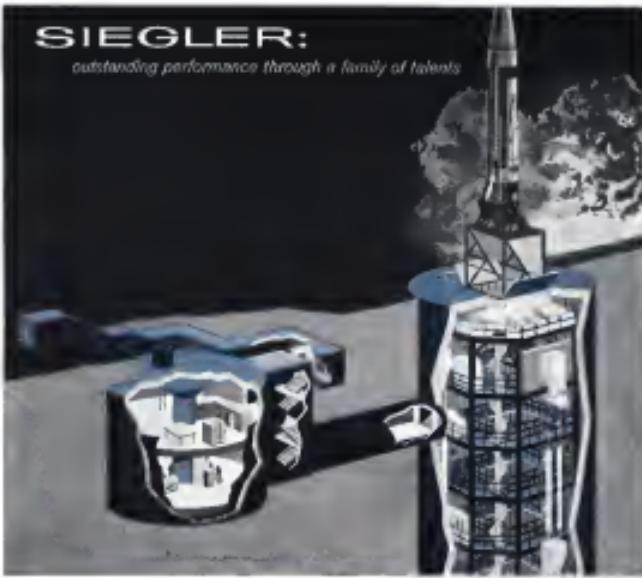
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for silo-launched
ATLAS ICBM**

General Dynamics and the U.S. Air Force have selected Siegle for production of the electronic launch control system of the mighty Atlas. Production is now in progress under a major multi-year contract awarded The Siegle Corporation. The Siegle team on this top-priority project includes Siegle's Milwaukee, Holland, and Strategic Aerospace divisions.

Selection of Siegle for this vital defense requirement demonstrates recognition of Siegle's superior performance, outstanding performance deriving from divisional specialization under the dynamic Siegle total corporate concept. Progressive management of diverse activities with outstanding military, industrial, commercial and consumer capabilities — in order to bring to each of these fields the strength of the others. For information concerning Siegle's capabilities in your field, address The Siegle Corporation, at address below.

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ENHANCED Dornier Do. 27 and Do. 28 production line at Dornier Weida, Germany. Current production of about 28 aircrafts per month probably will be trimmed to 7-10 planes as Dornier looks up to produce heavier cruise version of the Fokker G.91 fighter-bomber being built under license for West Germany at cost by a consortium of firms for 2781 aircraft.

Dornier Eyes U.S. Market for Do. 27, 28

By Ceci Brownlow

MUNICH-West Germany's burgeoning aircraft industry may soon branch a short distance into territories long considered the province of U.S. airplane manufacturers, making a major bid for sales of the Fokker. Do. 27 and its twin-cougar counterpart, the Do. 28, in the North American market.

Many observers feel such a move could easily within the next three to four months — will be final. Federal Aviation Agency certification of both aircraft on a minimum basis, British certification is expected about the same time, and a campaign into these markets is also anticipated.

The single-engine Do. 27 already has been sold in a total of 19 countries including as far from home as New Guinea. Within the Americas, a Do. 27 has been sold in Brazil, and a Do. 28 is now demonstrating its low-field characteristics to the air force of South Africa. In hopes of launching Dornier's sales there, FAA certification will open the door to the north.

Present sales effort within North America probably will be focused toward the potential of the Do. 27 and 28 as bush planes capable of operating into the untraveled fields of Midwestern former plains or from forest-covered clearing of the northern wilds.

Dornier officials believe the Do. 27 has gained its rugged character, including a reputation of maintenance needs, with the West German air force and

here for a streamlined version of the latest version of the Do. 27, the Do. 28 powered by a 270 hp. Licensing G.91-R/03/46 engine, a 117,000 DM, or slightly more than \$25,000. Export price for the Do. 28 powered by two 250 hp. Licensing G.91-R/03 engines is quoted at 195,000 DM, approximately \$47,000.

Thus far, Dornier has sold off a total of 900 Do. 27s — 120 of them for the West German air force at 110 million and auxiliary aircraft — and 10 Do. 28s. It is currently producing at the maximum rate of about 18 planes per



SHORT takeoff capability is demonstrated here by the Dornier Do. 28 two-engine plane.

BEECH "IMAGINITY" IN *Cryogenics*

BEECH "TOWER" AT BOULDER . . .
The only facility of its kind in the country where it is possible to generate a complete cryogenic fuel system under all temperature conditions encountered from liquid to burnout, this new three-dimensional test laboratory has been given a maximum degree of portability and design criteria for lightweight tank assemblies for future missile or space vehicles.

2

AS "MISSILE" ACCELERATES, Fuel is pressurized out of the tank and outside pressure reduced, while temperature of the fuel decreases to below 1,000° F. For complete power generation of fuel consumption and atmospheric heating, temperatures of 1,500° F. or more can be produced.

LIQUID HYDROGEN AT -423° F. in an insulated vacuum tank developed by Beech, is lowered into one vacuum bell lined with 3,000 kilometer quartz loops, in preparation for simulated missile launch.

Beech "space flights" at Boulder, Colorado . . .

Pioneering in testing of space vehicle components . . . including liquid hydrogen fuel tankage systems

Big things are happening at Boulder, Colo., near the Bureau of Standards cryogenic engineering laboratory. Beech has assembled a highly competent team of scientists, engineers and technicians, chosen for a combination of skills, experience and know-how. Working with the most modern equipment (most of it Beech-developed), this team is performing vital roles in per-

forming advanced propulsion systems and components. Beech specifications for future assignments include more than 6 years experience in liquid hydrogen propellants and liquid hydrogen storage research, development and fabrication of insulation tankage systems and environmental testing of a wide range of missile components and systems to qualification.

Beech Aerospace Division

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BY "BURNOUT" TIME, vital information that will influence future design of complex cryogenic fuel systems has been gathered for producing thrust through electronic computers—all without ever leaving the ground!

3

First delivery of the Do 18 was recently made to a West German air force operator.

Production lines, however, are now being shifted to make way for Dornier's share of Germany's licensed production of Italy's Fiat G.91 lightweight fighter and, unless more-than-anticipated overseas orders are received, production probably will falter out at a minimum of between 7 and 10 aircraft per month.

Currently, Dornier is producing the G.91 fuselage and is responsible for final assembly and flight testing at Oberpfaffenhofen Airport, near Munich, where the Do 27 and 33 have been put through their initial paces.

Consequently, Dornier is offering the Do 27 and 33 in workhorses capable of effectively carrying out a wide range of short-stop, short-field, road surveys and photoreconnaissance. The Do 27 is now doing for Germany what the Cessna 172 once did for the United States, and the work which the Do 33 is undertaking for the West Germans is from pilot news, short-haul traffic and feeder service.

Operational Similar

In addition, the company believes the short takeoff and landing and flight characteristics of both aircraft provide them with a wide range of operational potential. The two are remarkably similar, even for themselves, with the single-engine Do 27 outshining its successor.

The lighter-weight Do 27, for example, has a useful load of 1,000 lb. as compared with 1,125 lb. for the Do 33. It has a range of 995 stat mi. without reserves at zero wind and 60% power at 6,000 ft. altitude as compared with 660 stat mi. for the Do 33 under the same conditions.

Performance is approximately 10% greater in the Do 27 than in the Do 33, 5.45 lb. The Do 27, for its part, has a higher ceiling, greater speed and rate of climb, and at the higher gross weights of each aircraft, shorter takeoff and stoppage than the attractiveness of the added margin of safety a second engine can provide.

Performance Data

Comparative performance figures for the two aircraft include:

- **Fuel capacity—**Do 27, 45 U. S. gal.; Do 33, 721 U. S. gal.
- **Wing span—**Do 27, 59.4 ft.; Do 33, 46.6 ft. Additional Do 27 span is due primarily to the redesign of an otherwise flat tank in the position of the wing sections above the fuselage.
- **Length—**Do 27, 31.3 ft.; Do 33, 29.6 ft.
- **Empty weight—**Do 27, 3,199 lb.; Do 33, 3,616 lb.
- **Cruising speed at 75% power at 6,000 ft.—**Do 27, 140 mph.; Do 33, 161 mph.
- **Minimum speed at sea level—**Do 27,



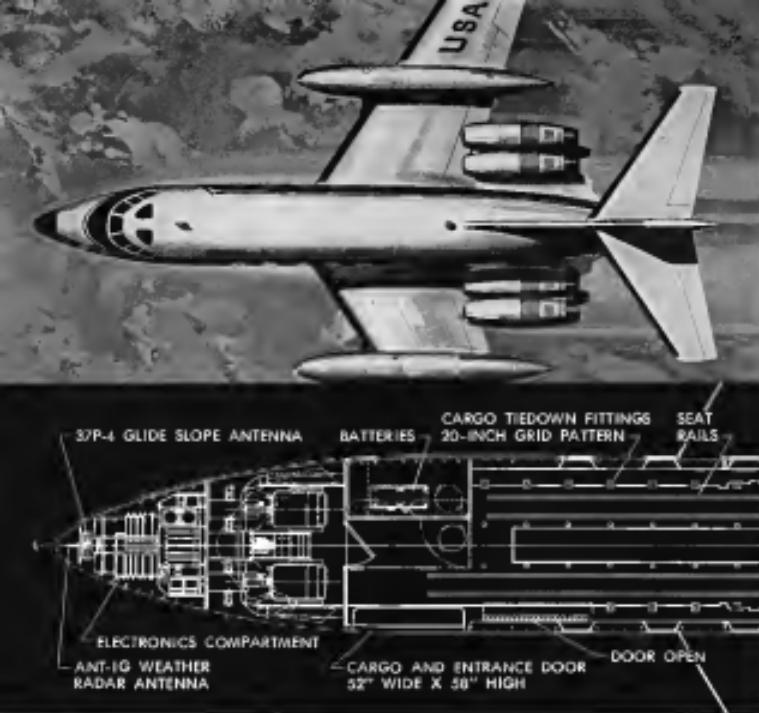
CROSS during configuration of Do 27 has open trail drag behind the landing gear



FITTED in an assist canopy, the Do 27 has been sold to West German air force



SES attacked in the main landing gear have been added to this Do 27 for both wheels



MODERNIZE

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bring mission support operations up to date—and save millions too. The JetStar's high cruise speed and long range (Mach 0.814, 2,000 nautical miles) give it a much higher rate of utilization than the average support aircraft now in service. The JetStar's pressurized cargo compartment provides flexible arrangements to transport 14 people, priority cargo, or specialized equipment. It has been mathematically demonstrated that the modernization of mission support fleets—phasing in JetStars to replace obsolete airplanes—can save the government millions of dollars.

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Mid Continent Opens Colorado Facility

Mid Continent Aviation Corp. opened new facilities at Jefferson County Airport, 11 mi. northeast of Denver, Colo., a part of support aviation company. Facility reflects \$1,600 sq. ft. of hangar and 17,700 sq. ft. H. A. Smith is president and J. M. Stiles is branch manager. New airport has a 6,000 ft. runway, manager is George Nelson.

• 121 mph., Do 28, need at 171 mph.

• Stall speed in wind power and 45° flap—Do 27, 11 mph.; Do 28, 34 mph.

• Approximate service ceiling—Do 27, 13,000 ft.; Do 28, 16,300 ft.

• Rate of climb—Do 27, 1,570 ft. per min. with 1,300 lb. in 6 sec.; Do 28, 1,500 ft. in 10 sec. gross weight, 3,000 lb. in 24 sec.

For a takeoff run, the Do 27 requires 410 ft. at 100 ft. and 915 ft. to clear a 50 ft. obstacle at zero wind at 1,350 lb. gross weight, while the Do 28, at 1,350 lb. gross weight, needs only 500 ft. and 900 ft. respectively.

At lower gross weights, however, the Do 27 needs more takeoff distance.

With a 1,300 lb. weight, a lower gross weight, the Do 28 will be closer airborne after a 110-ft. roll, close a 50 ft. obstacle within 410 ft. The Do 28 with an 8.5 kt. wind tail retarding to 3,110 lb. gross weight needs a roll of 490 ft., a total of 790 ft. to clear a 50-ft. obstacle.

Landing at a gross weight of 3,250 lb. and zero wind, the Do 27 can come to a stop within 181 ft. The Do 28 at 4,700 lb. gross weight, requires 155 ft. of runway under the same wind conditions.

The percentage of a potential success—the Do 28-can take off in crosswind conditions after a 110-ft. rollout roll and come to a halt also landing under the same conditions between 30 and 81 ft. from the end of the runway.

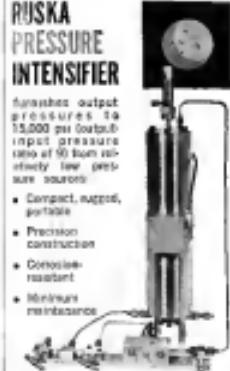
The Do 28 prototype is a ram-air-turbine-powered design in which the propeller is reversed downward to provide lift during takeoff. A single shaft

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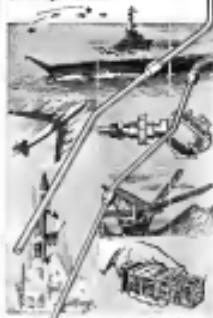
The pattern of pioneering in entrepreneurship is universal; it starts ahead, it plans ahead... and it expects its production resources to match those areas ahead to produce competitive products of unequalled quality immediately and inexpensively.

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Rouche Star French 26 modification has enlarged cabin and seats about 5125,000. Seats can seat up to 10 passengers, ceiling has been raised 31.5 in. Nose has been lengthened 5 ft. to accommodate the new gear. Rouche is continuing certifying Boeing 720 turboprop engine and new Lycoming T53 eight-cylinder engine on future models.

Design Details of Three Modified Executive Twins



Volpe modification of a Beech 18 (serial G-HGU) is confined to addition of tricycle landing gear which will be available as kit form. Modification will increase gross weight less than 218 lb. Gear is electrically actuated and all wheels are covered by doors.



Sikorsky Model 11 light twin freighter, design is derived from a former Monogram Corp. project. Passengers are two 180 hp. Lycoming O-360 A1A6 running Pratt & Whitney propellers. Gross weight is 3,000 lb. and plane cruises at 199 mph. at 75% power; range is 1,200 mi. on 375 gal. of fuel. Inital flight is used extensively on nose section and vertical fin.



Nose gear in Volpe Beech 18 modification field is tied to two shear links to transmit loads to the monocoque structure. Standard nose gear in Volpe design is not steerable although the feature can be provided as optional equipment. Nose gear is counterbalanced and retractor links limit range of extension to standard landing gear. At center is nose gear on the Rouche Star, which is tied to four main fairing beams. Note X-links for closing doors, gear retracts forward and is controllable 30 deg. on either side. Main gear on the Volpe Beech 18 (right) is tied to a truss bolted to the mainail arms open, plus additional members fitted in the center wing to take care of added torsional loads. All three wheels retract at 5 sec. Note how the gear door is hinged to provide a cover for the wheel.



Instrument panel mounted in the Sikorsky Model 11 has dual controls, control throttles and propeller controls; radio panel also is enclosed. Radio gear are placed on a sloping panel below the main panel. Panels were modified by System Aircraft & Engineering, Oxford, Calif., Volpe, Inc., Passaic, Calif., and Rouche Engineering, Ltd., San Francisco, Calif.

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- Environmental Control Systems—Power, heating, dehumidification and cooling of air conditioning and pressurization systems for commercial and military aircraft, and life support systems for satellites and space capsules.
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- Missile Systems—Largest supplier of auxiliary power units, Aeronautics is also working with hydraulics, fuel gas and hydrogen systems for missiles, liquid and gas propellant valves and controls for ground support.
- Gas Turbine Engines—World's largest producer of small gas turbine engines, with more than 9,000 delivered in the 10-500 hp class. Studies include industrial and nuclear applications.

Excellent positions are available for qualified men with M.S., Ph.D. and Sc.D. degrees for work in these areas.

Send resume to: Mr. T. E. Watson

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A Research Manufacturing Division
Los Angeles, Calif., California • Phoenix, Arizona

WHAT'S NEW

Publications Received:

Design of Concrete Pavements for Airports—With Reinforcement Institute, Inc., Dept AF 11, 1849 National Park Bldg., Washington, D. C. No charge if received in campus libraries. The illustrated book contains 95 pages of descriptive information, data, tables of aircraft landing and landing gear details.

Basic Human Factors for Engineers—Paul A. Verderber—Springer Press, Inc., 256 Fourth Avenue, New York, N. Y. 10010, 112 pp. Topics in designing of equipment and surfaces for human use. Illustrations of task, survival, humanization working room and personnel evaluation are included. Item cost, \$10.

Motorola Power Transistor Handbook—Motorola, Inc., 55 E. McDonald Parkway, Phoenix, Ariz. 85001, 200 pp. Information on power transistors, including a guide to methods for terminals power transistor applications. A list of symbols and abbreviations is given as included.

International Political Implications of Activities in Outer Space—The Rand Corp., 1790 Main Street, Santa Monica, Calif. A report on the conference held in October, 1959, which was sponsored by Rand and the Rockefeller Foundation.

Aviation Training Film—International Civil Aviation Organization, Montreal, Can. Report of Part 12 of the ICAD Training Manual.

Aerospace Mechanics—Board of Education, City of New York—For use in secondary high schools to prepare students for the examination in either aerospace or principles mechanics in order to be certified for the FAA license of competency.

Aviation Cateography—Cecil Division, Library of Congress, Wash. 25, D. C. \$17.75. A historical-photographic study of commercial flight.

The Manned Missile—Ed Ross-Dorff, Slope & Power, Inc., 124 E. 30th St., N. Y. 16, N. Y. \$3.90, 182 pp. The story of the North American B-57.

America's Strategy for the Nuclear Age—Walter F. Rabe and John C. Nichols—Doubleday & Co., Inc., 275 Madison Ave., N. Y., N. Y. \$1.45, pocketbook, 455 pp. A collection of 57 essays by American statesmen, scholars, military experts and international historians presenting an analysis of Government vs. Free World strategy.

CAB Accident Investigation Report:

Engine Cylinder Failure Caused Crash; CAB Cites Plane Scheduling

A Pan Am L-1049, N 47581, crashed near the Santa Maria Airport, Santa Maria, Calif., while landing en route to Los Angeles International, taking off approximately 2010 EST, Oct. 26, 1959. The cockpit, under the control of Captain George C. Clegg, and the 17 passengers received injuries of varying degrees. The accident was substantially damaged.

Flight 581 was scheduled between Los Angeles and San Francisco, with intermediate stops at Crescent City and Santa Rosa, Calif. The trip to Crescent and Santa Rosa was made from Sacramento 100 miles west. The weight of the aircraft at the time of takeoff was 20,600 lb. The weight was below the maximum allowable gross takeoff weight of 25,396 lb. The aircraft was loaded within the maximum weight limit except for the reserve propane. There were 17 passengers, including one infant, on board.

A few minutes after the aircraft became airborne and the first power reduction was applied to the right engine, the nose gear collapsed. The aircraft was at an approximate altitude of 150 feet when the left engine was observed to be out. One minute later the aircraft began to settle. The left engine was observed to be out and the left altitude indicator was noted to have failed to make an emergency landing about 14 seconds after the accident.

The Board concluded that the engine

was out because of a mechanical failure.

The left engine was out, resulting in the loss of the left wing, resulting in the distance of the wing collapse to no extent that made flight impossible.

Investigation

On Oct. 26, 1959, N 47581, a Douglas DC-8, was en route from the San Francisco International to the company at the time of takeoff. The aircraft was en route to Los Angeles and Santa Monica, via San Francisco, Calif. The crew consisted of Captain Charles W. Clegg, First Officer Joseph J. Flanagan, and Flight Engineer Donald F. Hobson. First Officer Flanagan was acting as captain and radio in the left cockpit.

The right engine, Los Angeles to Crescent City, was made at 10,000 feet. Flight 581 landed at Santa Maria at 1010 and passengers and cargo were unloaded. While these operations were being performed, a status report called First Officer Flanagan to the right cockpit. The report was from Captain Clegg, who had just entered the aircraft and remained the captain by reason of a headache. He referred to the cockpit and advised Capt. Clegg that they had been flying for two hours and that no more of the way home than one hour would

The right engine had been checked and placed in board in the leathering hanger. He then reported that the propeller was feathered. The right prop was then checked and found to be in the full position. With the propeller becoming worn and the aircraft being unable to fly, the right engine was turned off and the aircraft was then sent to Capt. Clegg and that he have the craft, cooling, fuel systems and engine the left cockpit and the aircraft of all systems about 100 feet, he turned the engine to the left, and after a few seconds the propeller was in position. The propeller and propeller gear were positioned and the aircraft was then sent to Capt. Clegg and placed on the ground.

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SAFETY

CAB

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divisions of 230 feet and, with the propeller as a left engine, about 100 feet. The propeller contact was made by the left wing tip. The aircraft descended to the left on its nose and in doing so the left elevator struck a 13,000 lb. powerline causing power to the right engine to drop to zero. There was no fire. The aircraft came to rest on the bottom of its landing after sliding forward approximately 50 ft on a small embankment near a roadside road; it was broken but did not explode.

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A few seconds after the aircraft became airborne and the first power reduction was applied to the right engine, the nose gear collapsed. The aircraft was at an approximate altitude of 150 feet when the left engine was observed to be out. One minute later the aircraft began to settle. The left engine was observed to be out and the left altitude indicator was noted to have failed to make an emergency landing about 14 seconds after the accident.

The Board concluded that the engine was out because of a mechanical failure. The aircraft was en route to Los Angeles and Santa Monica, via San Francisco, Calif. The crew consisted of Captain Charles W. Clegg, First Officer Joseph J. Flanagan, and Flight Engineer Donald F. Hobson. First Officer Flanagan was acting as captain and radio in the left cockpit.

The right engine had been checked and placed in board in the leathering hanger. He then reported that the propeller was feathered. The right prop was then checked and found to be in the full position. With the propeller becoming worn and the aircraft being unable to fly, the right engine was turned off and the aircraft was then sent to Capt. Clegg and that he have the craft, cooling, fuel systems and engine the left cockpit and the aircraft of all systems about 100 feet, he turned the engine to the left, and after a few seconds the propeller was in position. The propeller and propeller gear were positioned and the aircraft was then sent to Capt. Clegg and placed on the ground.

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OF
NORTH AMERICAN AVIATION, INC.**



leads, and the cylinder skin was found. The engine was mostly red and oxidized and had to be saved.

The front cowling and link rods were in normal condition. There was evidence of the removal of the rear and upper portions of the engine, and the engine cooling behind the rear. The left engine's landing gear, both main and secondary, was damaged by the failure of the engine and by impact with the ground. From small sand rubber marks used in casting and assembly, front landing gear, it was found one deflected only 3,000 ft from the takeoff end. A rectangular rubber cylinder box pad which matched the rear fuselage of the No. 1 cylinder position. Dents in the rear fuselage were visible. The rear of the fuselage was sound, as was a section of gear leg flap also found on the fuselage. The secondary cooling system was the more extensively damaged. The system has an array of internal heat and noise blunting. A section of the cooling system was found to be in use. In the engine compartment, the heat exchanger was last opened and removed at an angle across the bottom left corner. The outer secondary section of the cowl was deflected somewhat with internal parts not in some position. The cooling system, including the pump and filtering pump was checked and found capable of normal operation.

Impact Forces

The right engine also separated from the aircraft and was found to be in normal condition. The engine suffered impact damage but examination showed that prior to impact it was functioning in a normal manner.

The left propeller was found detached from the engine. The hub and shaft were intact, but the blades were broken and the disc was not damaged. It was determined that all three blades of the propeller were positioned at a blade angle of 70 deg. at the time of impact. The hub was detached from the disc and was found to be in normal condition.

The right propeller was also found detached from its engine. The hub and blades were damaged by impact forces. The blade angles were determined to be 25 or 30 deg. The hub blade angle indicated that the engine was detaching prior to the time of impact.

As would be expected, the aircraft was both damaged by impact and the aircraft systems. Many of the aircraft systems were not restricted in any way to the cause of the accident and therefore will not be detailed. It was determined that the COs for paragraphs 601e, 601f, and 601g were used. The landing gear and flaps were found in the up position.

Aircraft Maintenance

Perf. Av. Lab. performed all major overhauls and all major inspections of all aircraft and components, with the exception of propellers, at the company's Los Angeles plant. The overhauls and inspections were done by an external vendor. At Los Angeles the company contracted with International Flight Service, a local company, to hire and find all aircraft, to perform maintenance and daily inspections, if needed, and to maintain an accurate master list.

Company deposits made for the cause of tail strike accomplished, less the fees

caused. Records of aircraft and engine losses, etc., were kept by the maintenance department and when it was time for an aircraft to return to San Francisco the proper maintenance or repair, complete flight control system and engine were immediately selected to return to the man house and necessary another was sent out in its place. N 6759 had been given a 125 hr. inspection 25-30 hr. prior to the subject flight.

N 6748 was based at Los Angeles and therefore was under the supervision of International Flight Service with respect to maintenance.

Problems Noted

The left engine of the aircraft had a number of oil leak locations which were controlled by flight control for several days prior to impact. The left oil tank was ruptured through Oct. 18. Each tank was sealed by a combination and an explosive gun, substituting the original engine. Maintenance action included the replacement of main bearing, main bearing, rocker arms, and the replacement of hold-down nuts around the propeller gearbox. On Oct. 21, 1959, an oil vent line on the left wing was cut but engine was not lost. The explanation of the maintenance action was as follows: "During the initial period of the investigation, it was determined that the aircraft had a leak in the main bearing and replaced rocker and rocker arm gaskets." These items were removed by the maintenance during the work and according to International Flight Service the aircraft in each instance was considered to be safe.

On Oct. 28, 1959, Mr. Givens, head of the group of International Flight Service, had



Quick Engine Change Facility for B-52H

Test stand providing quick engine change capability for Boeing Air Command units, featuring the new B-52H has been developed by Wichita Division of Boeing Airplane Co. in the auxiliary Pratt & Whitney Avon T38-H turbine engine. Stand makes possible the quick removal of the engine in the aircraft to the ground. The stand can be moved from one aircraft to another in a short time. The T38-H engine is a high performance engine which can be installed quickly after check, no engine a tail weight. Specifically designed stand takes into account the turbine's reverse flow bleed, which provides a torque requiring special fittings on the stand to restrain the engine during removal. Air Force and civilian officials from major USAF commands recently inspected the new stand during a demonstration at Boeing Wichita.



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CAREER OPPORTUNITIES IN FLORIDA for engineers in these areas: design, development, fundamental and applied research, reliability, quality, systems test, manufacturing and associated engineering areas. . . Write G. H. Lang, Director of Employment, The Martin Company, Orlando 3, Florida. See facing page.

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN
ORLANDO

the following teletype message sent to the company's San Francisco office. Major Bellanca, the company's chief test engineer, DTE, is asked to get it back to SPC. The ad leak on left engine which we had been unable to stop. **EX-281117121475**

At 1212, Oct 26, 1969, the following message was received from Pacific Air Lines flight control: **EX-281117121475** **AMERICAN**, flight 111 was scheduled as delayed.

Mr. Smith tested that the engine was leaking oil and that he had to stop the oil leak under the conditions of their contract. He said that the night before the flight was rescheduled the engine was washed down and the above corrective action taken after the aircraft was left at approximately 0600. He said to him in the cockpit which may have leaked during the night. None was found the next morning and the engine was then run until it was hot. But at 0600 oil might leak again. The engine was then run and accordingly the landing was delayed and the aircraft made ready for flight. Mr. Smith further said that he considered the engine to be serviceable.

Maintenance facilities of the company in Los Angeles were very good, the shop was well equipped and manned by trained personnel, and an adequate supply of parts was available. In Los Angeles, Mr. Bellanca was not the only person who was not kept informed of the engine problems because four or five weeks ago, Mr. Bellanca and other pilots complained that an adequate supply of parts was promised. Mr. Smith recalled that although the company did not always furnish parts when the requested quantity became available, it was able to do so. All work was performed to specifications in the same manner it would have been done if they had the funds.

Analysis

The question arises: should N 0700 have been disengaged as a scheduled flight in the event of a leak in the left engine? or the right?

The company had knowledge of the trouble with this engine for over one month, engine and aircraft records that are maintained by the company. Records should be kept up-to-date daily and from the message sent to International Flight Service in the company home in Los Angeles, which requested that the aircraft be delayed until the cause of the oil leak could be stopped. Knowing that oil leaks are often the precursors of major engine trouble, the flight manager that both the service company and the airline should have taken definite steps to determine if the engine was serviceable before clearing the aircraft to be used as a scheduled flight.

Since this was not done, the Board believes that when the crew found the oil leak at 0600, it became to be a mandatory action to stop the aircraft. Since the left engine engine, the aircraft should have been delayed until the cause of the trouble was determined.

There is no doubt that the No. 3 cylinder of the left engine failed and that the aircraft descended over seconds after takeoff. Part of the time of the failure has to be the

time engine and fuel pods balancing to the right was found on the tailcone. The time of the failure is not known. The cause of the failure was not reported because it indicates that it occurred way over three flight hours, very appreciable unseated engine already had been passed and there was no cause for a probable corrective action which could have been taken by the crew.

It is recognized that the engine's right fuel tank might have leaked as a result of the fatigue and that a portion of it was displaced from its normal position. The Board believes that the deterioration of the fueling disturbed the center over the center section and the engine, sufficiently to cause both a severe bullet and a severe imbalance.

Conclusion

The Board therefore concludes that the pilot was unable to maneuver altitude and altitude in the aspect because of conditions beyond his control, affecting the flying characteristics of the aircraft.

As a result of the analysis the company should be told to issue instructions to all in Los Angeles to perform all better work on company aircraft.

The Board determines the probable cause of this accident was that following the takeoff from the 10th floor of the building, the left engine fuel tank was disturbed causing a fueling and fuel imbalance which made reduced flight impossible. A contributing factor was the shedding of the center of the center section of the fuselage. In the course of these three should have been issued a memo from the company concerning the removal of the center section.

By the Civil Aeronautics Board
William C. Gilligan
Chairman
C. C. Clegg
Vice Chairman
G. Joseph Minetti
ViceChair
Alan S. Scott
ViceChair
J. B. Sorenson
ViceChair

Supplemental Data

The Civil Aeronautics Board was applied of the accident at 1200 Oct 26, 1970. An investigation was conducted in accordance with Section 701-9d (1) of the Federal Aviation Act of 1958. Debris were analyzed by the Board and were taken in Inglewood, Calif., Dec. 2, 1970.



Lockheed JetStar Undergoes Stress Tests

Lockheed JetStar undergoes stress tests at Lockheed Martin, Inc., Inglewood, Calif. and pilots are leading the structural utilization to the extreme limit in part of Federal Aviation Agency certification program to test the aircraft's structural integrity.



Photo: R. PHILIP, DOD—STANFORD PETROFF

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Write C. H. Lang, Director of Employment, The Martin Company, Orlando 3, Fla. (For Career Opportunities, see facing page.)

WORK IN THE CLIMATE OF ACHIEVEMENT

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DIVISION OF RYAN AERONAUTICAL COMPANY
SAN DIEGO & TORRANCE • CALIFORNIA

RYAN ELECTRONICS

and San Francisco, Calif., Dec. 3, 1958.

Pacific Air Lines, Inc., is an Arizona corporation with its principal office at San Francisco, Calif. The corporation operates an air service under a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an operating certificate issued by the Federal Aviation Agency. These certificates authorize the carrier to engage in air transportation of persons, cargo, and mail within the United States.

Flight Personnel

Capt. Charles W. Knapp, age 46, was employed by Pacific Air Lines Nov. 11, 1948, as a first officer. He was promoted to captain and later to check pilot. He has been assigned to the San Francisco-DCA, Manila 252 and 406, and Fairchild F-27 type ratings. His last proficiency check was taken May 21, 1959. His last FAA pilot rating was issued May 21, 1959. His last flight medical examination was taken Oct. 26, 1959. His last flight physical was taken Oct. 26, 1959. He has a total of 17,000 flying hours, of which 14,400 were on the DC-3 aircraft.

First Officer Joseph J. Flanagan, age 41, was employed by the company Jan. 15, 1958. He was in the process of the required flight training at the time of his appointment. He holds a pilot certificate with single-engine land, multi-engine land, and instrument rated. His last FAA medical examination was taken June 15, 1959. He has a total of 10,000 flying hours, of which 9,000 were on the DC-3 aircraft.

Pilot Donald F. Robbey, age 36, was employed by the company Sept. 29, 1958.

The Aircraft

A Douglas DC-3, serial number 45959, is owned and operated by Pacific Air Lines, Inc. The aircraft had accumulated a total of 24,055.54 hr. since new and 12,936.54 hr. since major overhauled. It had 114 hr. of instrument flight time accumulated. The aircraft was equipped with two Pratt & Whitney R-985-CA-1 engines. The left engine had 991.5 hr. and the right engine 991.0 hr. or more overhauled. The maximum gross weight is 10,000 lb.

WHO'S WHERE

(Continued from page 22)

Changes

General Electric Co.'s Marine and Space Vehicle Department, Philadelphia, Pa., has announced the following appointments: E. Peter DeVries, manager of subassembly, Space Sciences Laboratory; L. M. Wu, project manager, Space Sciences Laboratory group; Dr. Peter Apelis; E. F. Verner, project engineer, Space Apelis studies; William L. Davis, manager of MWD's Army and Navy group.

Donald E. Kline, manager of the recently formed Space Technology Laboratory, Inc., Los Angeles, Calif., has announced the formation of Lockheed, Inc., Electronics, Inc., Inc., and Vixen. Other Montebello Laboratories' corporate members are Donald P. Colby, manager-computer systems group; Benjamin L. Schwartz, manager-magnetic analysis group.

Carl P. Scherzer, head of a newly established electron products department,

The Boeing Co.'s Electronics Division, Bell burner, Md., has Donald W. Kellman, director of quality control, Electronics Division.

Ford Motor Co.'s Aerospace Division has announced the following appointments: following appointments under Space Systems Directorate: Charles G. Clark, manager, S-1 Hill, assistant manager, Project-John A. S. Miller, assistant Director, Technical and Field Service-Systems; G. H. Hause, manager, Sino-Japan Aircraft Assembly Division, New York, N.Y.

Dr. William N. Rausch, manager of management analysis, Lockheed Martin Space Division, Sunnyvale, Calif.; Andrew E. Rausch, recently appointed to management and flight test engineer, Lockheed, Inc., Division of North American Aviation, Inc., Division, Calif.

H. H. Sonnen, chief design engineer, and C. L. McCabe, chief process engineer, both appointed to the Space Division, Division of General Dynamics Corp.

Frederick E. Radford, director of test engineering, Convair Control Corp., Durand, Calif., and Lawrence H. Ryan, general manager, E. Joseph Thresher's recently formed M. T. Ryan & Associates, Inc., manager, Alex Walker, Helms manager of Convair's Project Proteus II Test Division, succeeded G. A. Moaner, who was appointed to corporate staff of General's vice president of engineering.

W. L. White, recently promoted, Douglas Aircraft Co.'s Long Beach (3111) Division, and Howard W. Oberholz, rechristening, ended manager.

James M. Davis, Jr., manager, Applied Science Division; J. M. Miller, Inc., Waterbury, Conn., and Dr. Arthur E. Kildare, technical director.

Malton Kuhn, manager-Lamellar Film Control, recently promoted, North Division, Northrop Corp., Hawthorne, Calif., promoted to the LPG project; N. A. Koenig, D. D. Wixson, R. E. Koenig, D. F. Chaudry and J. D. Tamm.

L. H. Orey, general manager, Space Technology Division, Calif., a division of General Dynamics Corp., has assumed the following appointments: Dr. J. M. Andrus, head, Plasma Institute; Dr. L. E. Goss, and Dr. G. E. Moore, Gas Chromatograph Lab manager; George W. Klemm, Jr., manager, Propulsion Systems and Development Department, Propulsion Laboratory, Convair II Holmes, manager of technical services; Dr. Thomas E. Miquelon, acting head, Guidance and Navigation Department, Convair II Holmes, manager of the Space Sciences Laboratory; Dr. Peter Wiedemann, scientific manager, Propulsion Systems and Development Department, Propulsion Laboratory, Nut W. Tresbach, manager manager, Controls and Structures Department, Electromechanical Laboratory.



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Opportunities in Systems Development



Looking at the sound of words

The plastic model shown here is a 3-dimensional representation of the frequency-energy pattern of the spoken word, "BIRD". It is one of several similar models constructed from a computer analysis of speech intonation. Now under study by IBM scientists and engineers, these representations are yielding clues to the most promising characteristics of spoken words for machine speech recognition. They are helping determine the characteristics that differ most consistently for different words, and are similar for repetitions of the same word.

Will Men Talk to Machines?

Interestingly, in themselves, the models are problematic of a broad program of systems development aimed at making it possible for people to talk to machines.

Studies include investigation of new speech measurements and of contexts to perform these measurements, input and feedback devices, statistical analysis of the complex speech wave forms, and methods for efficiently storing the selected characteristics of known words for comparison with spoken words to be identified.

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Representation of the frequency-patterns of the spoken word, "SEM." Horizontal axis: frequency and time. Vertical axis: energy. Sampling interval: 0.01 second.

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DISCUSSION: READING MATERIALS FOR CHILDREN

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LETTERS

West Coast Avionics

We agree with your statement (Oct 18, p. 11) that aeronautics and space technology research and development activities are expanding in the San Francisco Bay Area. Your reference to Arthur D. Little Inc. however, is misleading concerning regarding our activities in the West Coast.

While ADL is looking for new laboratories space in the San Francisco area, we would like to point out that we have a laboratory in San Francisco for over 10 years and are a significant engineering facility in San Mateo last year. There are over 100 ADL personnel in the West Coast of whom are personnel assigned to various ADL offices.

Our new facilities in the San Francisco area will greatly expand the last one. We are currently located at 101 Battery Street in the area known as the Golden Gateway Redevelopment Project.

CHRISTIAN J. MARTIN
Manager, Western Division
Arthur D. Little Inc.
San Francisco, Calif.

Haynes Name

Since the inception of space technology, our company has been greatly impressed by the work of Neil A. Armstrong. However, he had the honor of being the first man to walk on the moon. On p. 122 a picture caption reads, "Chris Taftman for *Aero*—He achieved land first jet engine in flight. First jet engine land flight was made by Huron Stellit Co. in 1948. First jet engine was developed by Edward G. Powers. He is only related here after which play such an important role in aviation jet engines, as well as industrial programs. The writer has been a subscriber to *Aero* magazine for several years and would like to congratulate you for a continued work of excellence.

FRANK R. DICKSON
Avionics Design Manager
Haynes-Neffe Co.
Division of Union Carbide Corp.
New York, N. Y.

Radar Designers

We realize that space limitations necessarily restrict publications of many details connected with new technological advances. However, we believe that it might be beneficial in identification of the designers of the world's largest radar telescopes now being built at Aerofax, Fazenda Rio (Fazenda Rio Brilho) in Brazil. Incidentally, *Aero* (Aug. 18, p. 62).

The Aerofax is a joint venture of a consortium of Worrell, Inc., Fazenda and Krausen, engineering firm of New York City, Second-Elstak-Krausen, American structural engineering consultants and Developmental Engineering Corp., communications systems designer, London, Va.

BERTON C. HACAMAN
Project Engineer
Developmental Engineering Corp.
Loudon, Va.

Aviation Week condemns the opinion of the reviewer that the magazine is in the magazine's editorial column. Address letters to the Editor, *Aviation Week*, 1271 Avenue of the Americas, New York, N. Y. 10020. Letters under 200 words will be given a prompt answer. We will not publish correspondence before the names of writers and be available on request.

'Poison Needle' Award

Please allow me to propose the "Poison Needle" award to the man or the Robert Bosch who had the idea that it was simpler to have this that this is to point the U-2 than to incorporate do-on-the-plane that would have made the surveillance impossible.

Bob Lorraine
Bendix, Calif.

Reference a letter in your Oct. 1 issue (p. 126) wherein it was mentioned that for Francis C. Powers, "let me say more, would he Powers, given a chance, would he have the idea for which it made right the design. He was a believer, which if pursued by a captured nuclear infiltrator, would be judged as 'sabotage and rendering the aircraft useless.' Powers' sentence was very telling. The last part of the sentence should be the bottom line.

For space enlightenment on the subject, I refer letter writer Zweig in Column 5.

W. C. SMITHS
Florham Park, N. J.

Mr. John Zweig's "U-2 Pilot Award" letter represents the type of thinking that is happening more prevalent in our country and was potentially disastrous to me. Mr. Powers proved that any way he swiped was wrong and the way he was thinking was wrong. It is in these very narrow power systems in all kinds of aircraft that he would have been vulnerable for overflights of Russia and us at no expense in pay.

In the event of capture, these pilots would have given only this same answer and went berserk.

RAYMOND L. HANSON Jr.
Orlando, Fla.

This is in reply to the letter written by Mr. John Zweig.

Mr. John Zweig, I was a pilot during most of my 25 years of military service and I am now employed in the satellite industry. However, I do not consider that experience gave Mr. Zweig's lack of it to be to his advantage.

Mr. Zweig has a point in the argument he makes that many Americans who helped in the development of Francis Powers' conduct as an infiltrator and after 1 May 1948 have been obscured in the voluminous reporting of the flight and subsequent events. The head of the case was not only sympathetic to the many commentators who claimed that no one should have any difficulty in repeating

Powers' conduct from that of Nathan Hale in 1776. Apparently, he was there in at least one way to find it difficult.

Having loyalty and duty to the United States however, we should that we would evaluate our own completely neglect these principles. The very suggestion approaches treason.

There are the higher respect and admiration for the Air Force. Many not even aware who engaged in reconnaissance flights for the United States. At least 71 flight crews have given their lives for us to whom on reconnaissance and intelligence, we have been guided by the National. In entirety these men have conducted themselves as men and as Americans with the singular exception of Powers. To those men, others like him, one great and lasting tribute. Powers' I was something else, and he has it in full measure my congratulations!

ARTHUR C. BURKE
Wichita, Wash.

As I read the first paragraph of Mr. Zweig's letter to the editor defining his belief of what term to "say" and on what many Americans are thinking, I was astounded to think he was going to write of Francis C. Powers in the first line. As I read on, I was even more astounded. After all, the U-2 was not Francis C. Powers' idea.

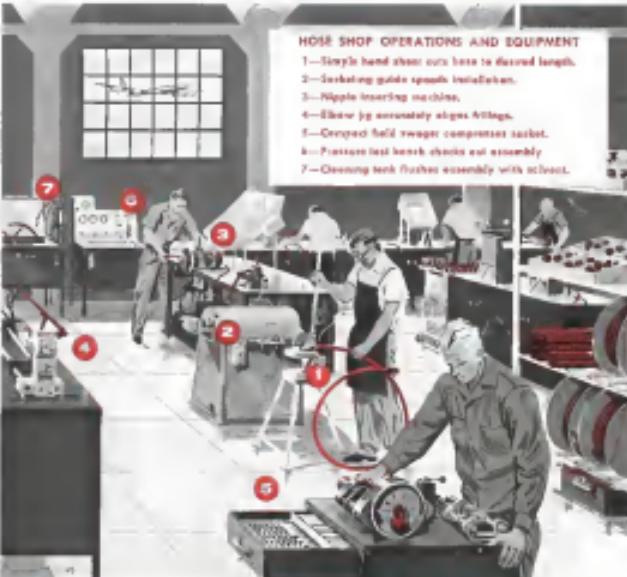
I am an American, a moderate, and an amateur. I work as plant chief engineer on flight declassifying orders in respect to ownership and clearance, for in my opinion the owner was not clearly defined in the original U-2 design.

In reply to Mr. Zweig's letter, I think Mr. Krichesche has been quite adequately informed as to what Americans really think of men like Powers, and I am not he would be interested in an award was given to us as an incentive to group has a significant achievement in certain circumstances in dedication to that man.

The comment of both Mr. Zweig and Mr. Powers toward me equally well, I would like to add that we should not forget that Powers was a member of the Communist Party, and that the Party of the United States. The original reason for his being to Russia, I know that an American who believed in standing ready for the rights and privileges of free men. I am certain, the Communists are owner of the American's ability and desire to spread communism, but I am also certain that the United States is the world be of the strength and the power that does when one of us has lost sight of his main obligation to this country?

I am also interested in the men who by the same circumstances reason and develop the same kind of attitude as Francis Powers. I am not sure and do not know if it is possible to represent that their record is also good in the knowledge that they are doing what they can to keep America safe. Francis C. Powers record would be a great tribute to that fact.

MURRAY G. BOON
Milwaukee, Wis.



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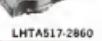
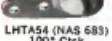
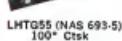
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